High-Resolution Bio-Optical Property Fields in the Northern Gulf of Mexico: Five-Year Ocean Color Time Series

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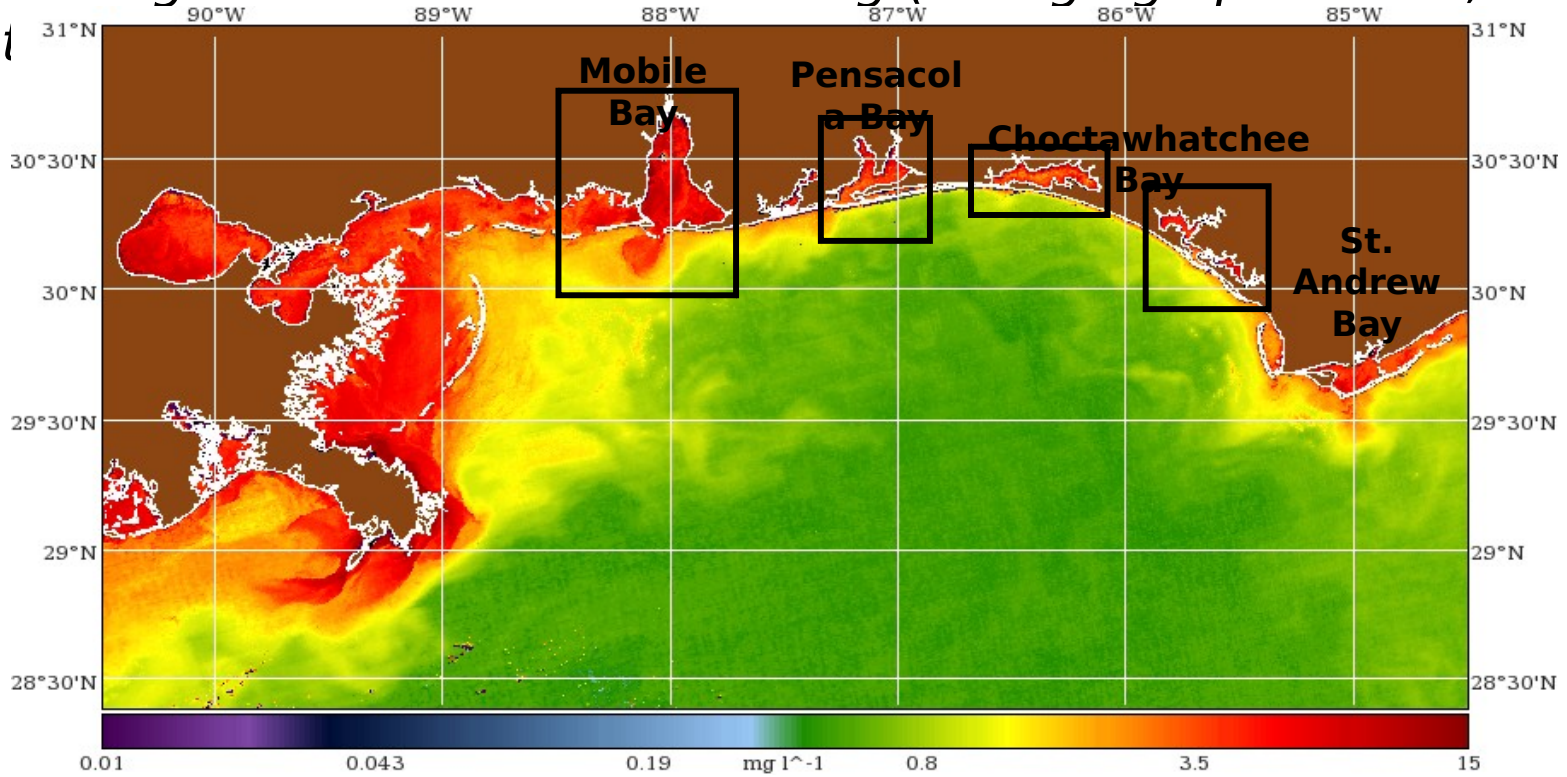
Objectives

- *Establish baseline bio-optical properties for coastal habitats in the Northern Gulf of Mexico (5-year satellite climatology).*
- *Communicate this information to environmental resource managers to aid decision making (dredging operations,*



o-Optical Products - MODIS Aqua, high-resolution (250m)

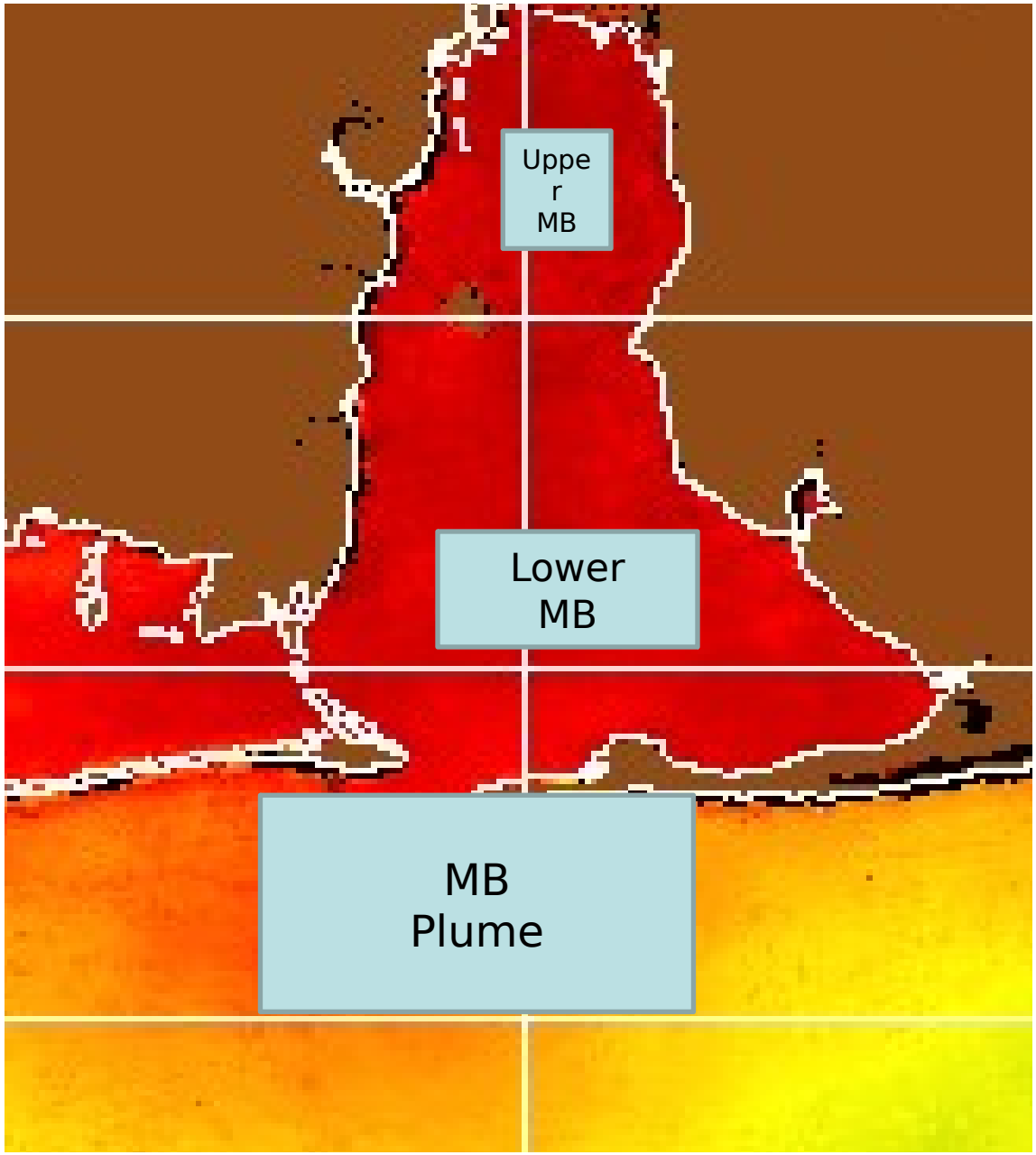
or each bay and sub-region; weekly, monthly products):

Total Suspended Solids (TSS) Particulate Inorganic Matter (PIM)

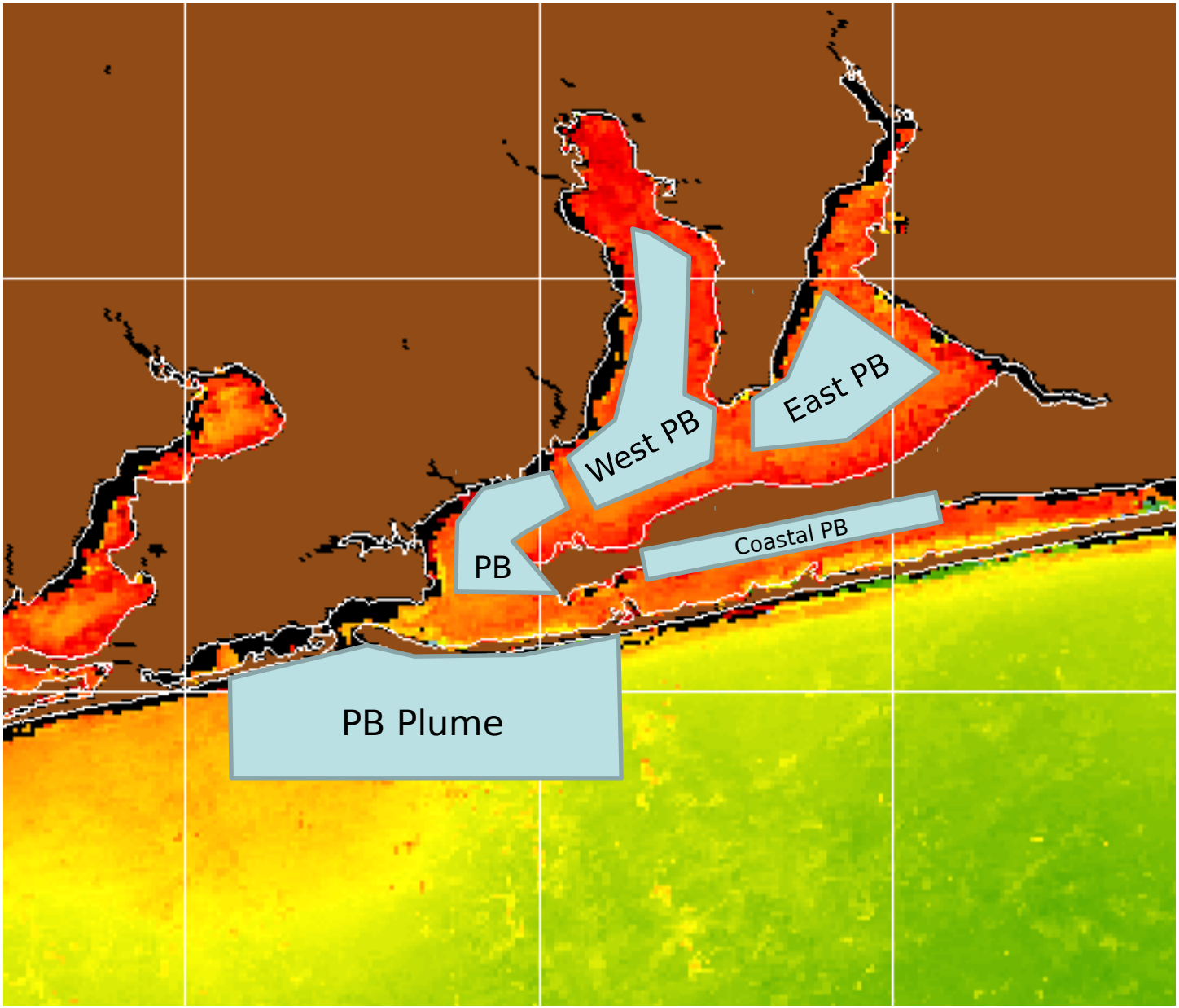
Particulate Organic Matter (POM) Diffuse Attenuation Coefficients at 488nm (Kd

Euphotic Depth (Zeu)

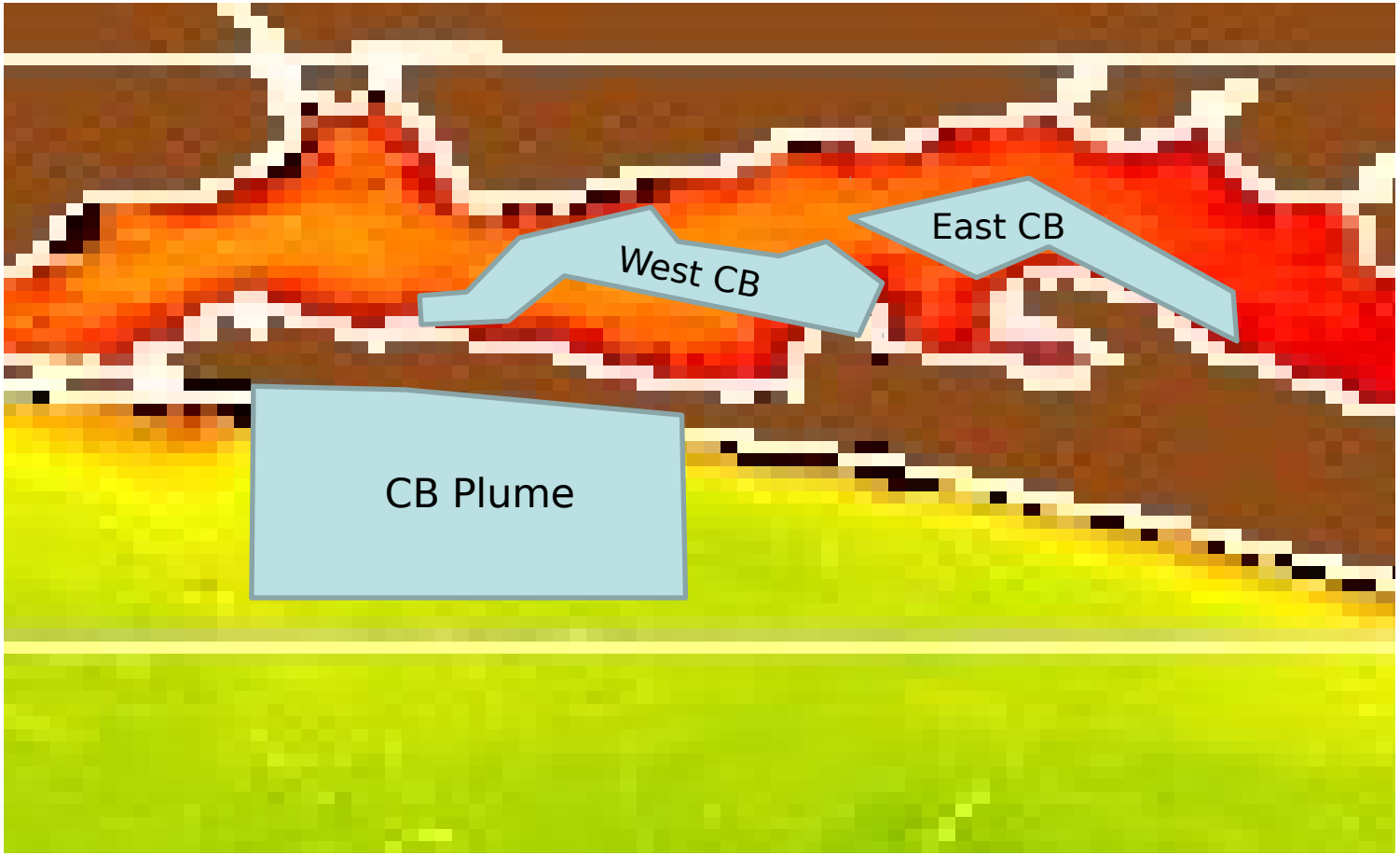
Mobile Bay, AL



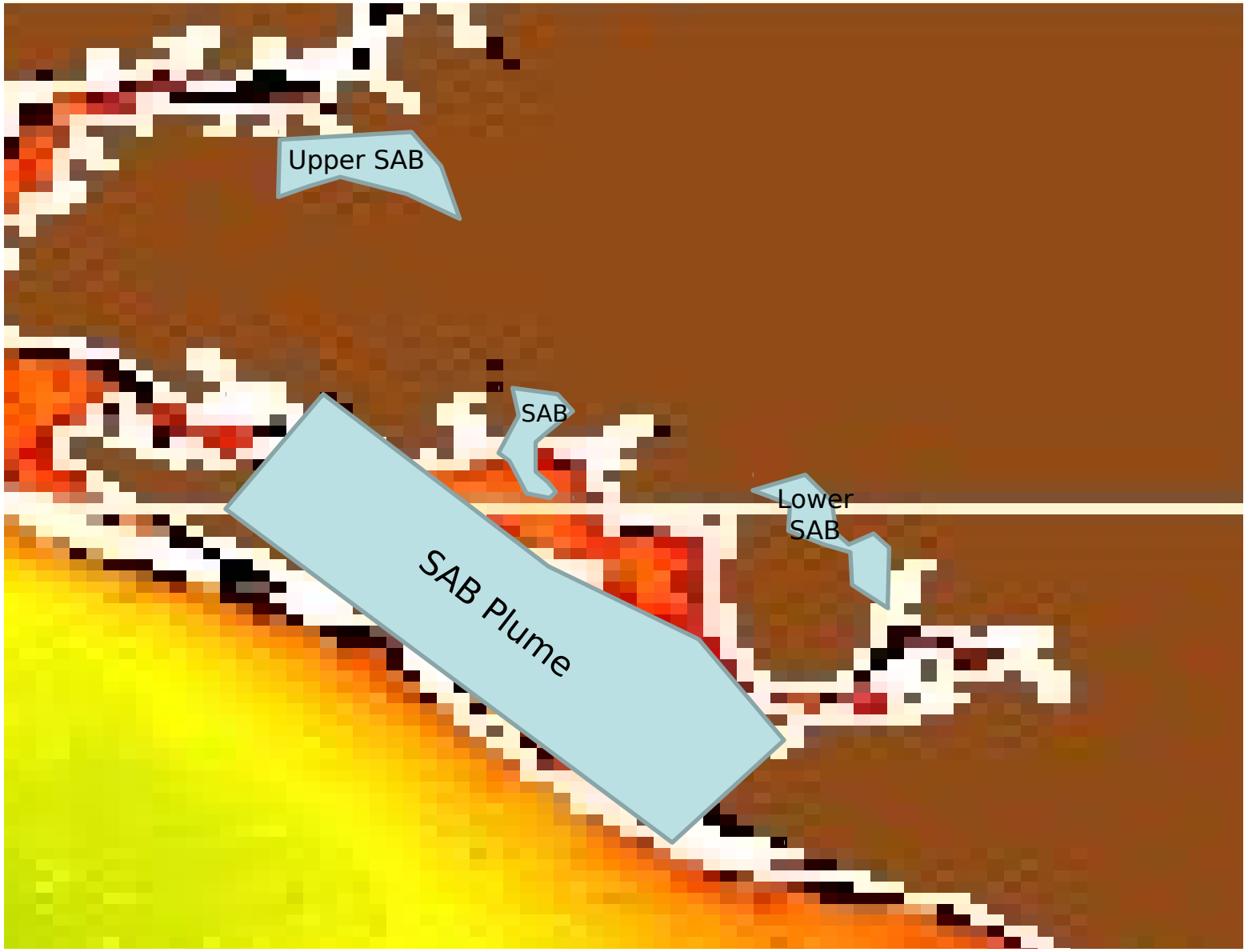
Pensacola Bay, FL



Choctawhatchee Bay, FL



Saint Andrew Bay, FL



Hyperspectral Imager for the Coastal Ocean (HICO)

NRL controls HICO operations

- *Target selection*
- *Target acquisition*

HICO Specifications

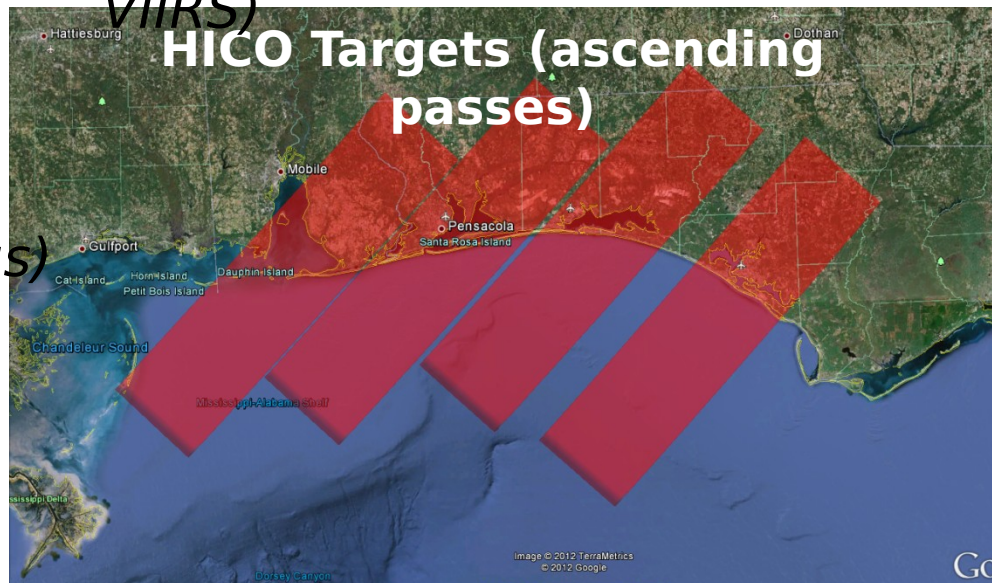
- *100m spatial resolution*
- *87 spectral channels (400-900μm)*
- *5.7 μm spectral resolution*

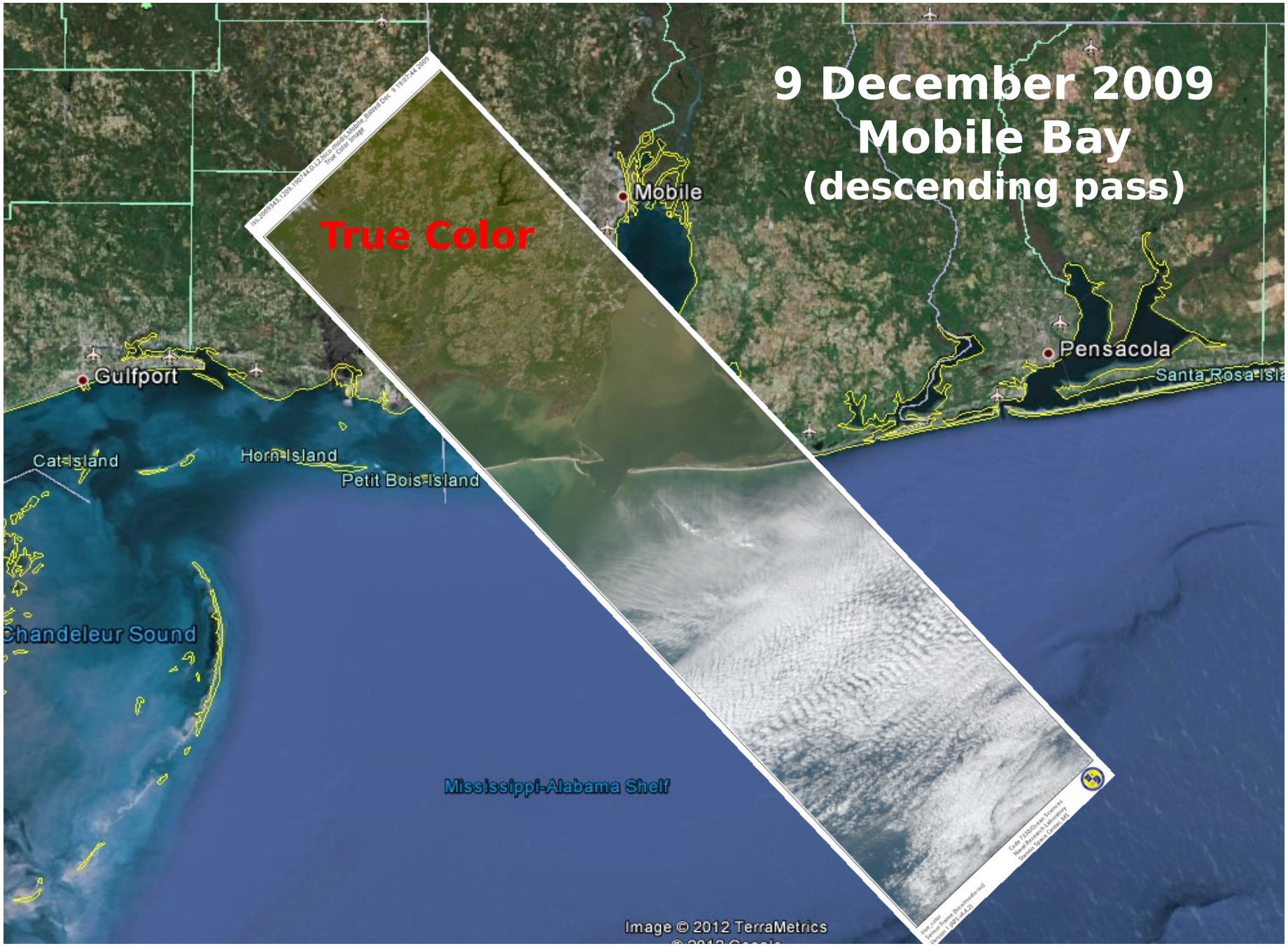
o-Optical Products

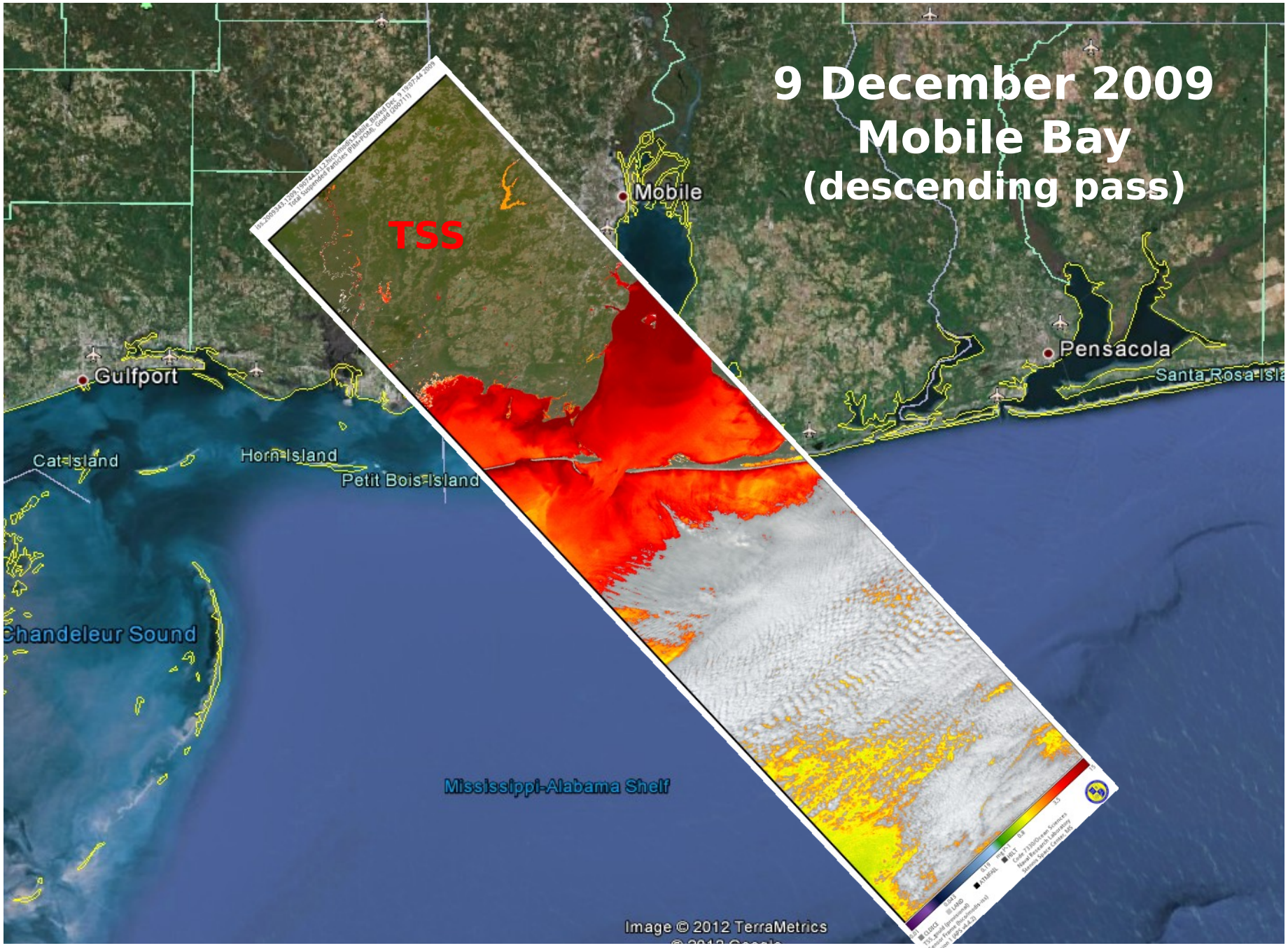
Chlorophyll
Absorption coefficient
(phyto, CDOM, sediment/detritus)
Backscattering coefficient
Diffuse attenuation coefficient
Beam attenuation coefficient
Euphotic depth
TSS (organic, inorganic)
Optical water mass classification

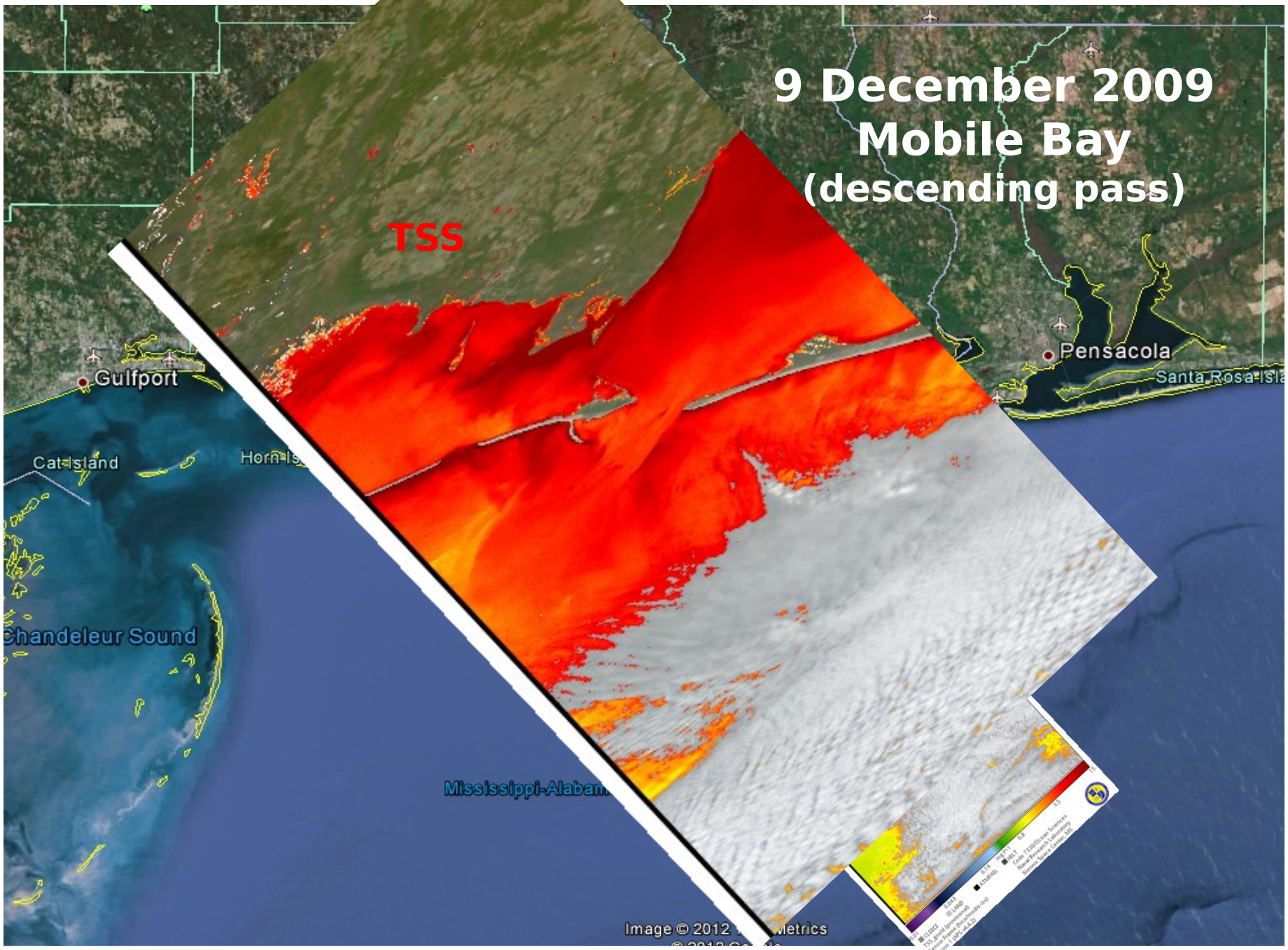
HICO Processing

- *Convolved to "MODIS-like" bands (multispectral)*
- *Full hyperspectral*
- *Consistent with processing for other ocean color sensors (SeaWiFS, MODIS, MERIS, VIIRS)*



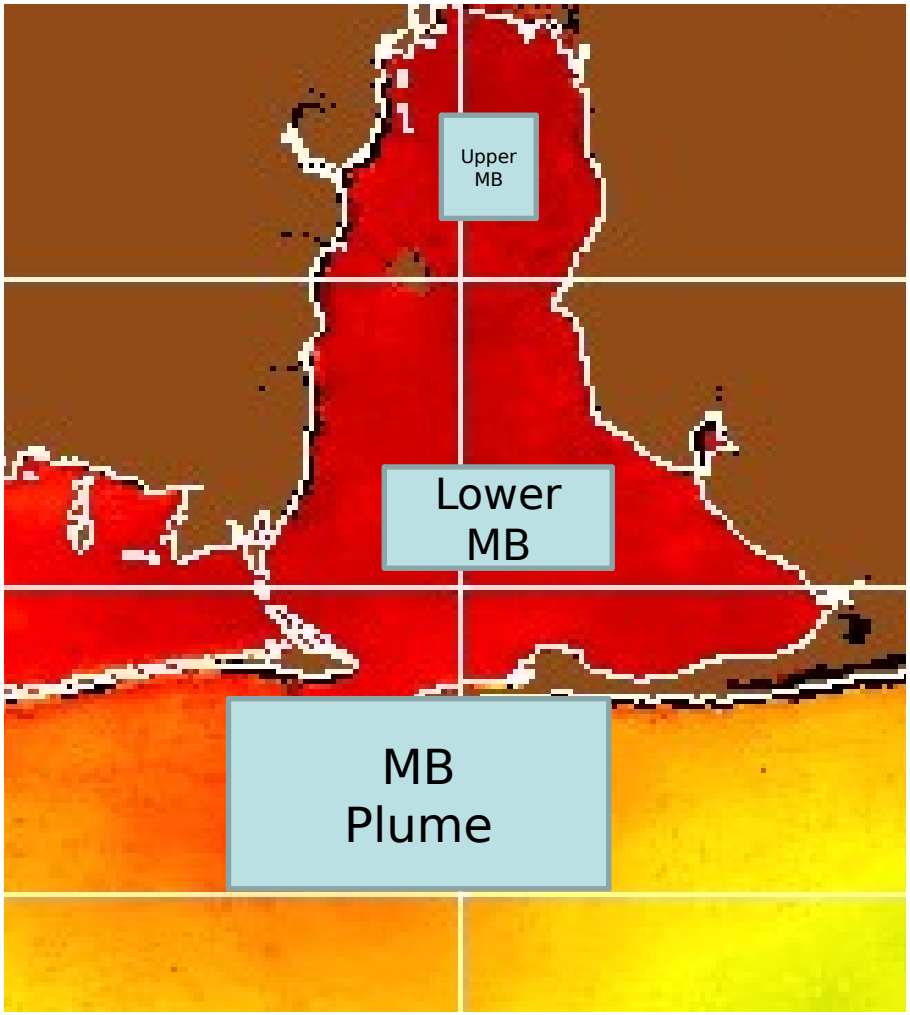

9 December 2009
Mobile Bay
(descending pass)
True Color
Mobile
Pensacola
Gulfport
Cat Island
Horn Island
Petit Bois Island
Chandeleur Sound
Mississippi-Alabama Shelf
Image © 2012 TerraMetrics


9 December 2009
Mobile Bay
(descending pass)
TSS
Mobile
Pensacola
Gulfport
Cat Island
Horn Island
Petit Bois Island
Chandeleur Sound
Mississippi-Alabama Shelf
Image © 2012 TerraMetrics


9 December 2009
Mobile Bay
(descending pass)
TSS
Gulfport
Pensacola
Santa Rosa Isl
Cat Island
Chandeleur Sound
Mississippi-Alabam
Image © 2012

Mobile Bay, AL

MODIS time-series



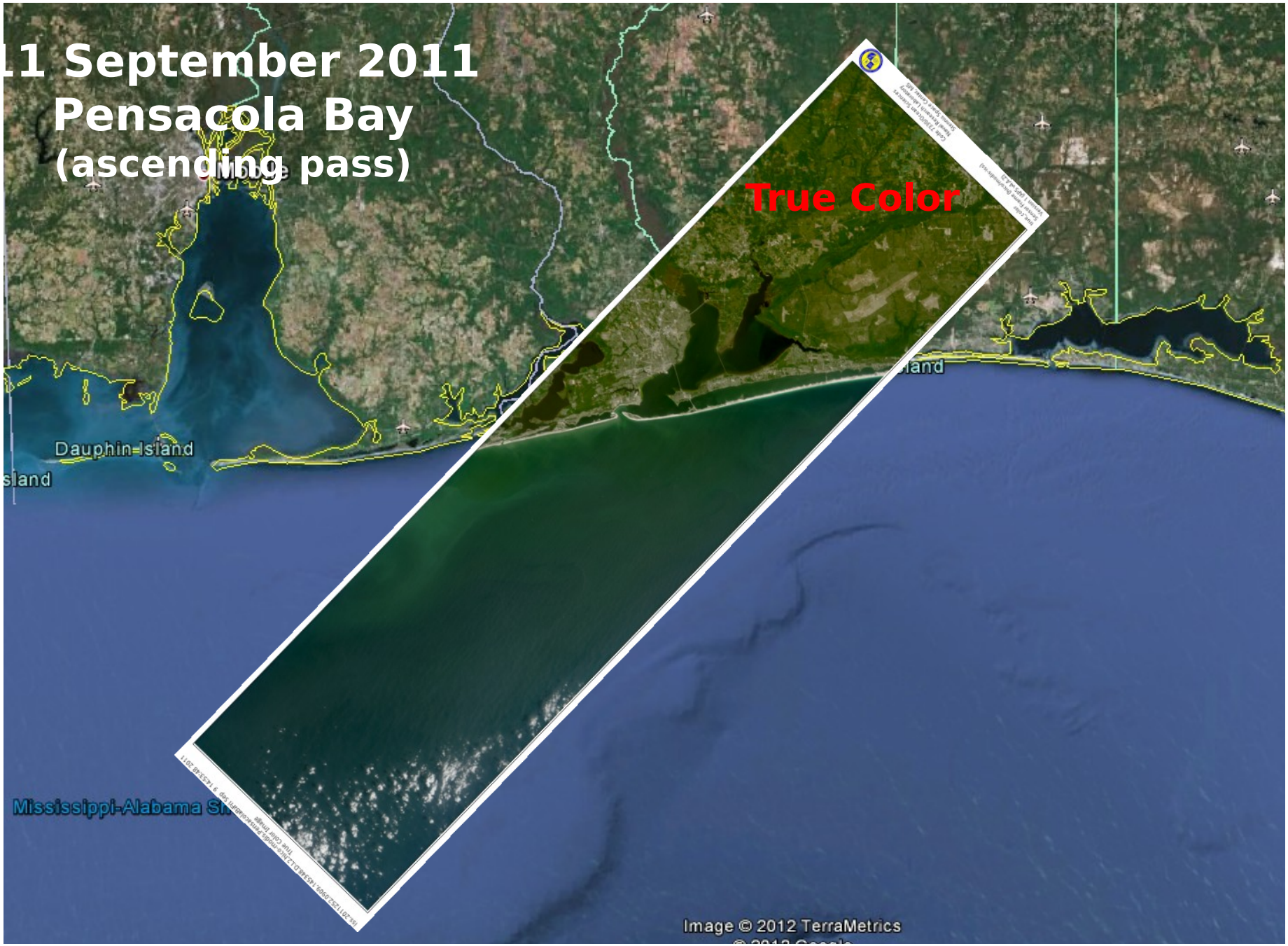
HICO (single image)

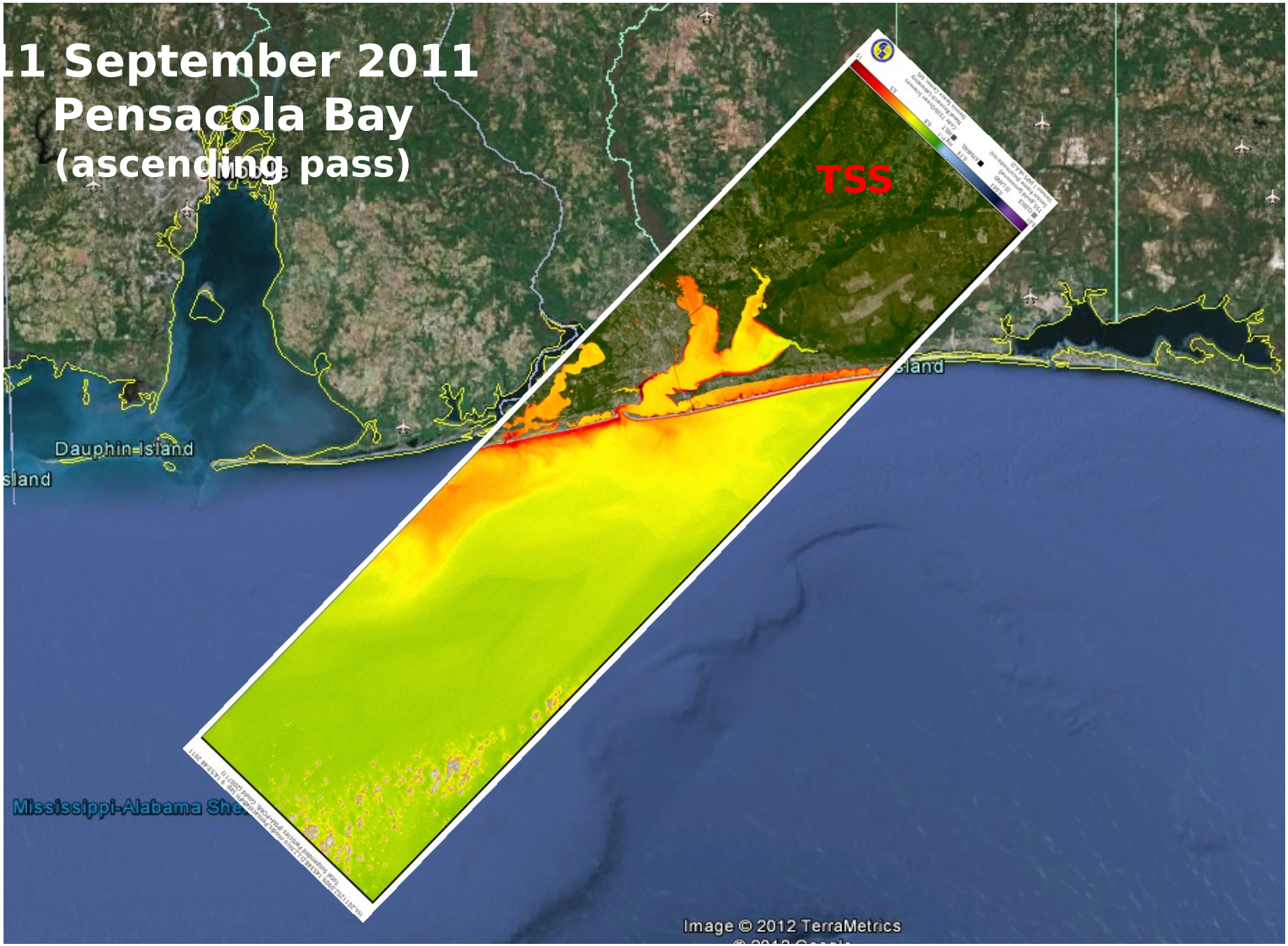
- ***not exactly the same areas covered by the sub-regions.***
- ***weekly mean vs. individual scene.***

MODIS (weekly mean, 12/3-12/10/2009) vs. HICO

Region	Property	MODIS time-series	HICO	|% Difference| (HICO – MODIS)
Plume	TSS	4.0	4.7	*17.5*
	PIM	3.1	3.9	*25.8*
	POM	1.0	0.7	*30.0*
	Zeu	11.0	9.0	*18.2*
	$K_d(488)$	0.63	0.61	*3.2*
Lower Bay	TSS	9.5	6.5	*31.6*
	PIM	8.1	5.6	*30.9*
	POM	1.4	0.8	*42.8*
	Zeu	4.5	6.6	*46.7*
	$K_d(488)$	1.68	0.96	*42.8*
Upper Bay	TSS	11.8	17.7	*50.0*
	PIM	10.4	16.7	*60.6*
	POM	1.4	1.0	*28.6*
	Zeu	6.1	3.1	*49.2*
	$K_d(488)$	1.89	2.14	*13.2*

generally increasing differences

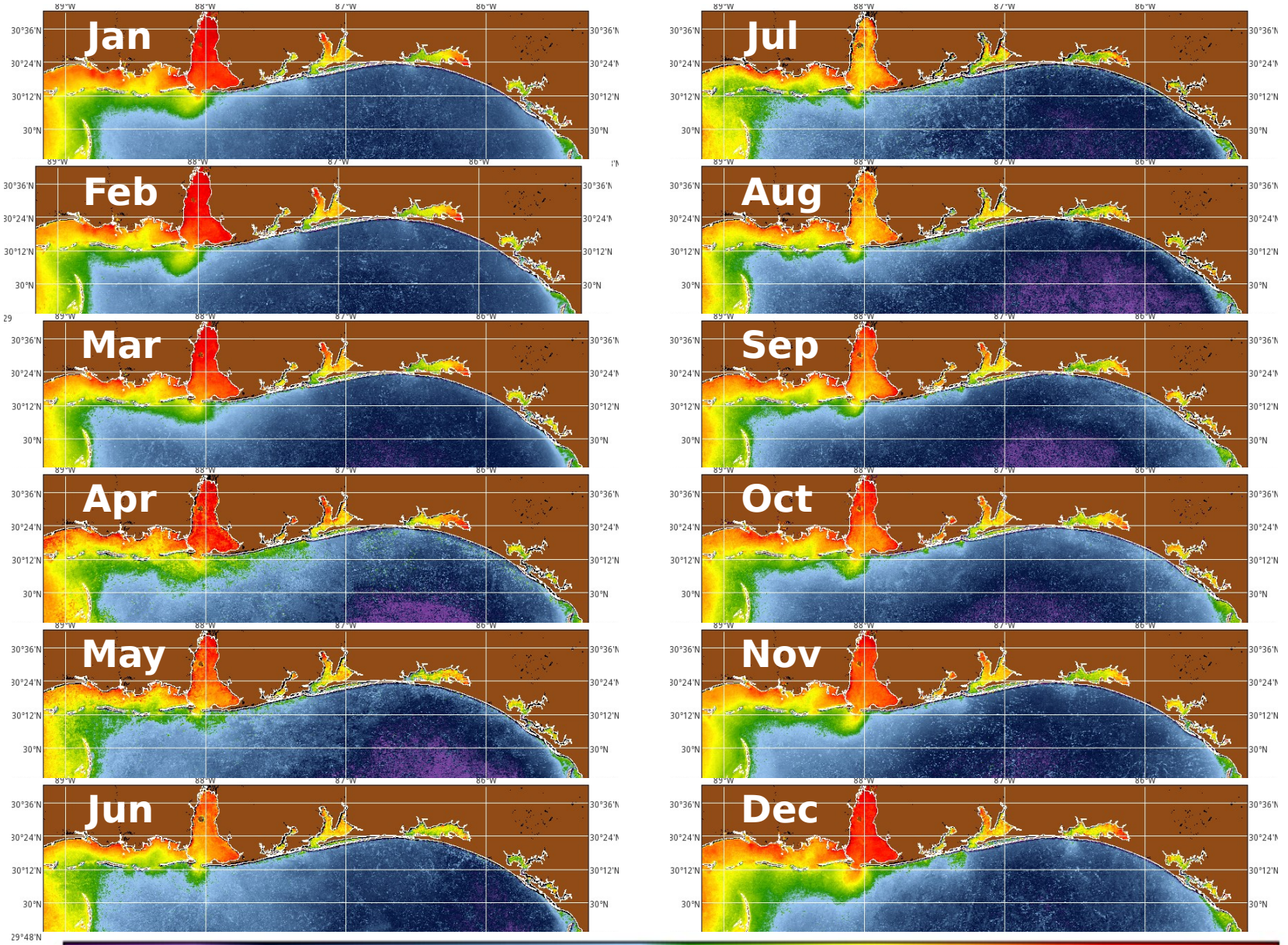

11 September 2011
Pensacola Bay
(ascending pass)
True Color
Dauphin Island
Mississippi-Alabama Sh
Image © 2012 TerraMetrics


11 September 2011
Pensacola Bay
(ascending pass)
TSS
Dauphin Island
Mississippi-Alabama She
Image © 2012 TerraMetrics


11 September 2011
Pensacola Bay
(ascending pass)
SPM
TSS
Pensacola
Santa Rosa Island
Dauphin Island
Mississippi-Alabama Shelf
Image © 2012 TerraMetrics

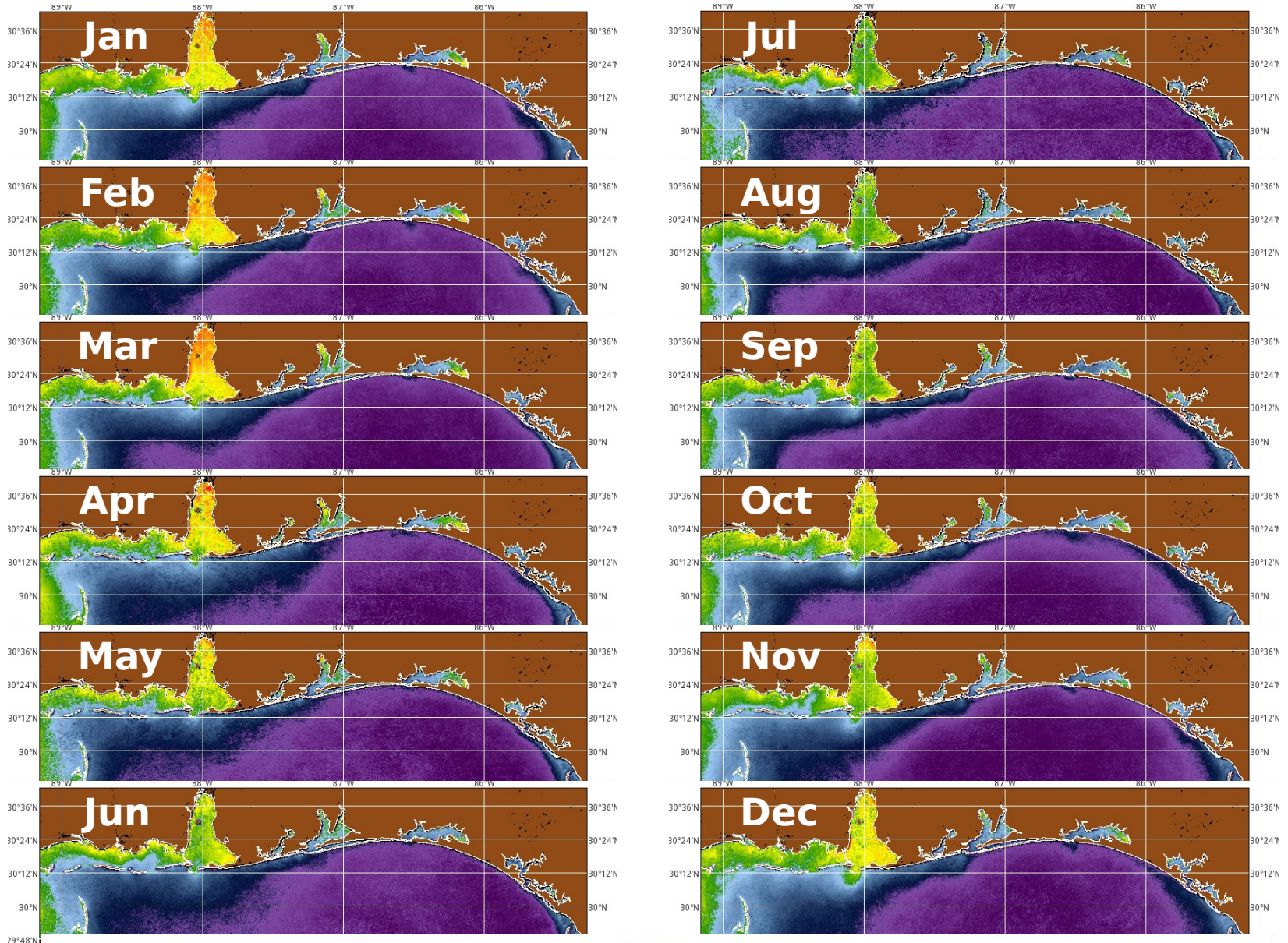
Time-Series Analysis – MODIS High-Resolution (250m) Bio-Optical Products

Monthly Composites (2005-2009), K_d (488)



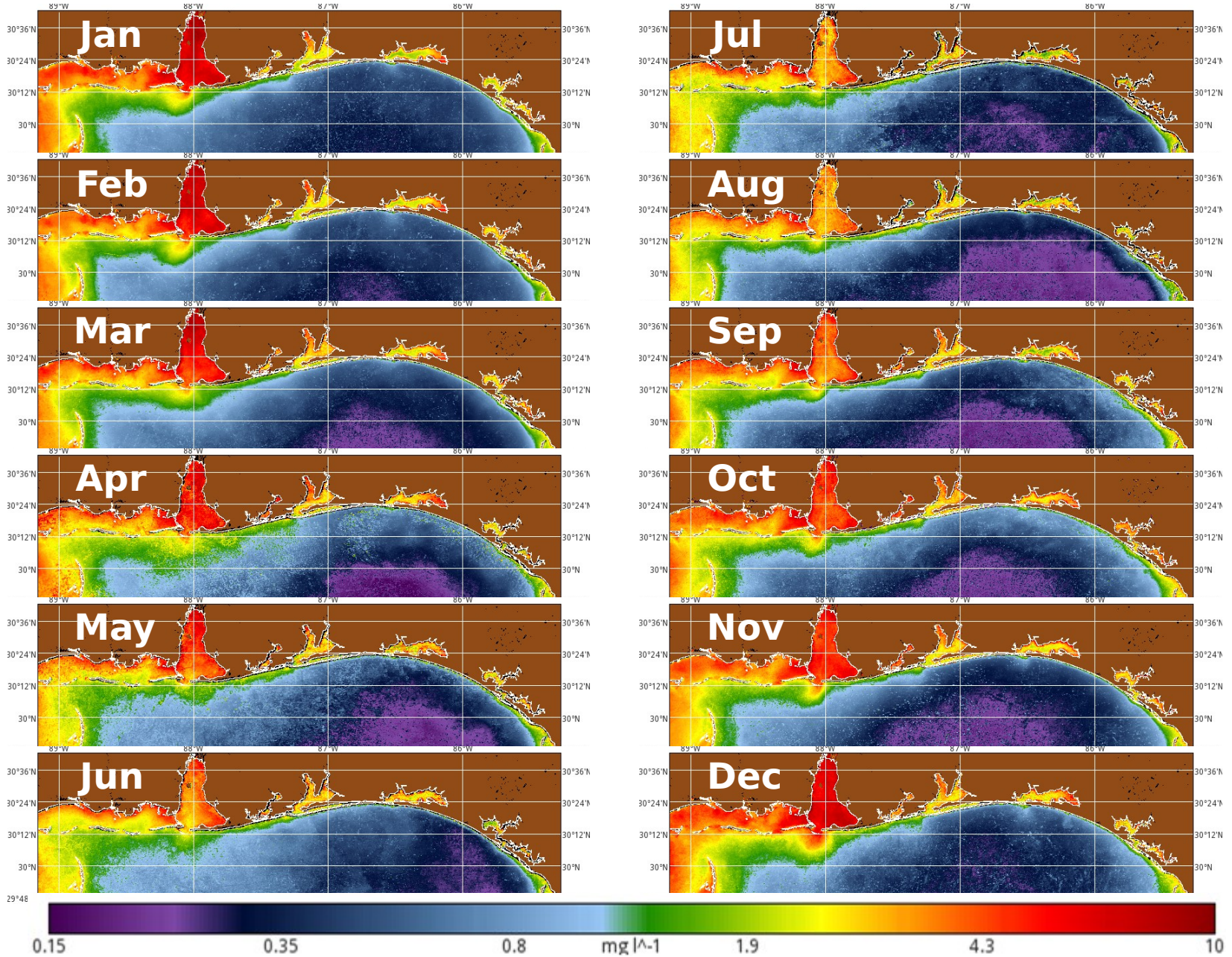
Time-Series Analysis – MODIS High-Resolution (250m) Bio-Optical Products

Monthly Composites (2005-2009), Z_{eu}



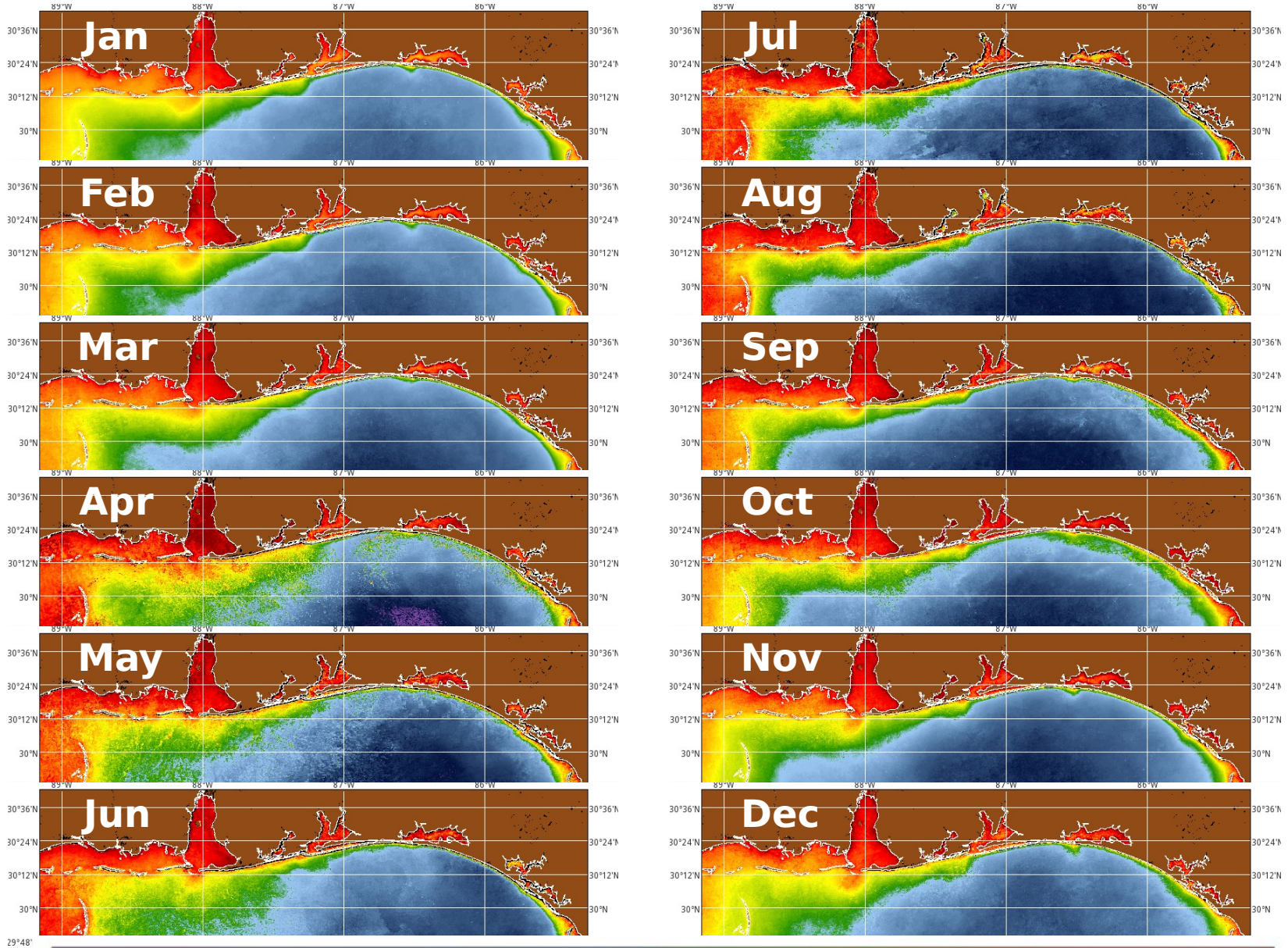
Time-Series Analysis – MODIS High-Resolution (250m) Bio-Optical Products

Monthly Composites (2005-2009), PIM



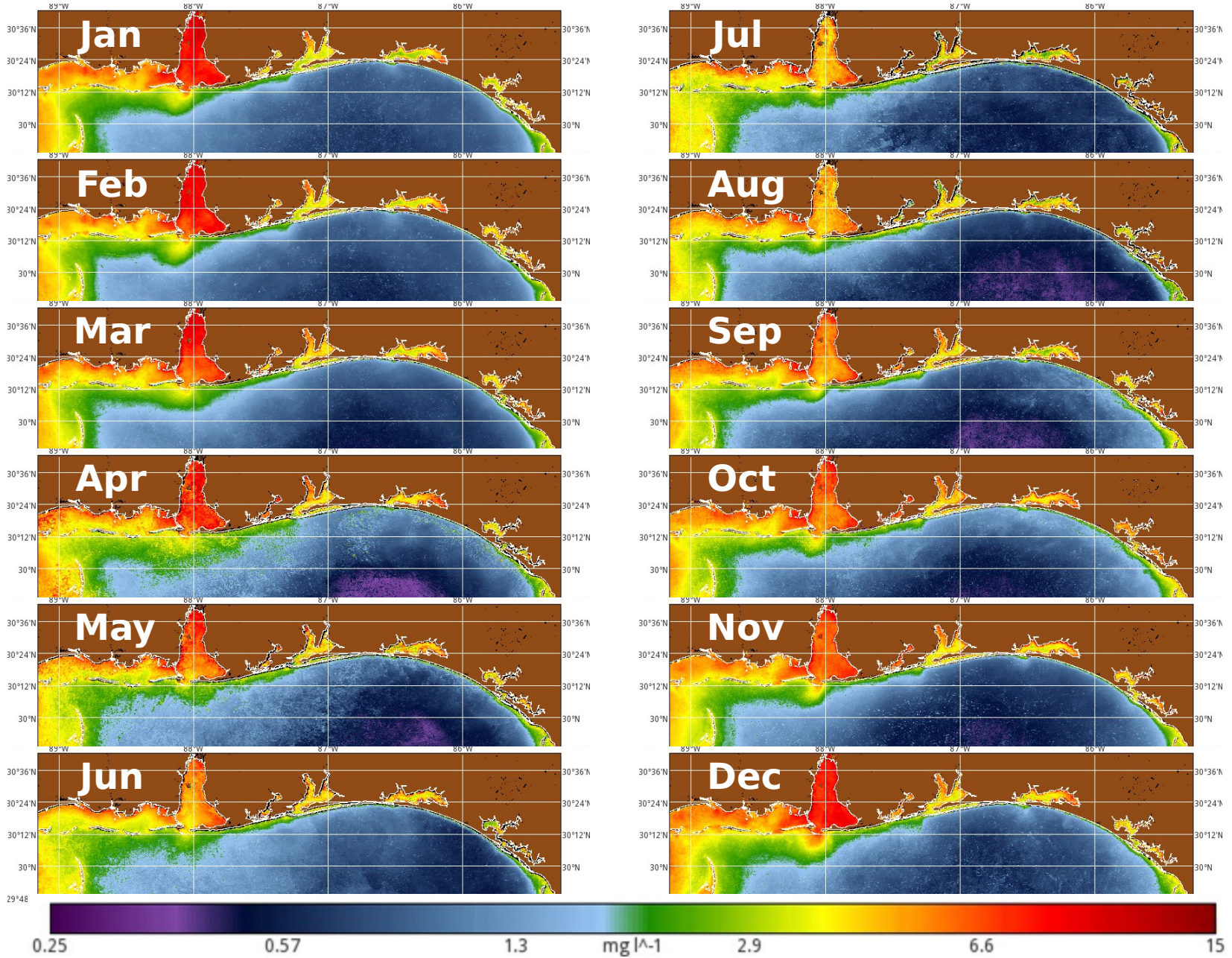
Time-Series Analysis – MODIS High-Resolution (250m) Bio-Optical Products

Monthly Composites (2005-2009), POM



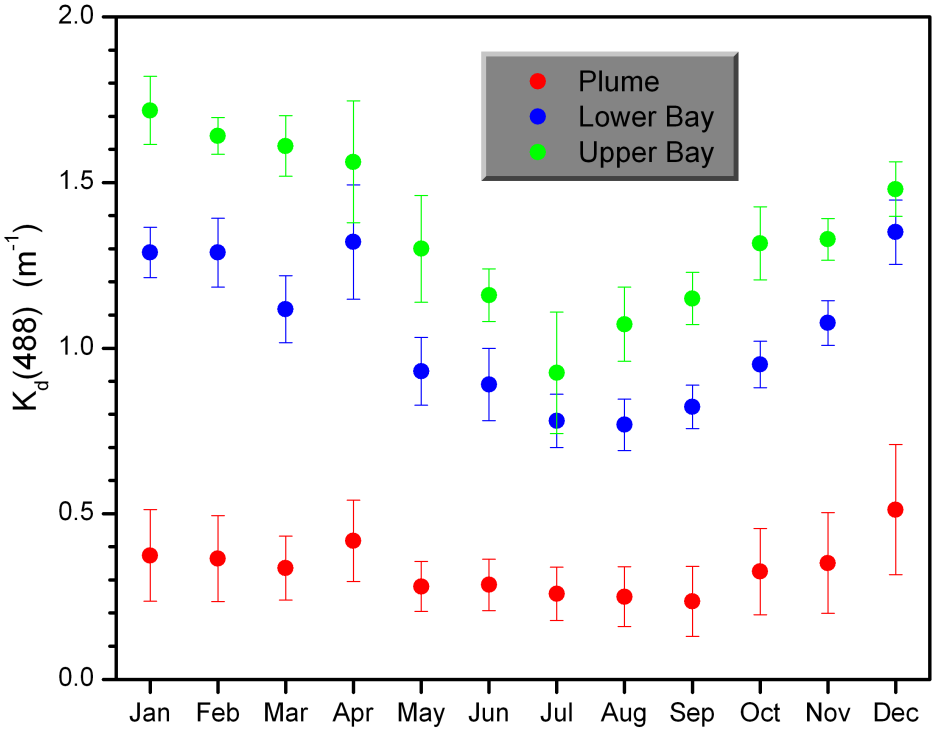
Time-Series Analysis – MODIS High-Resolution (250m) Bio-Optical Products

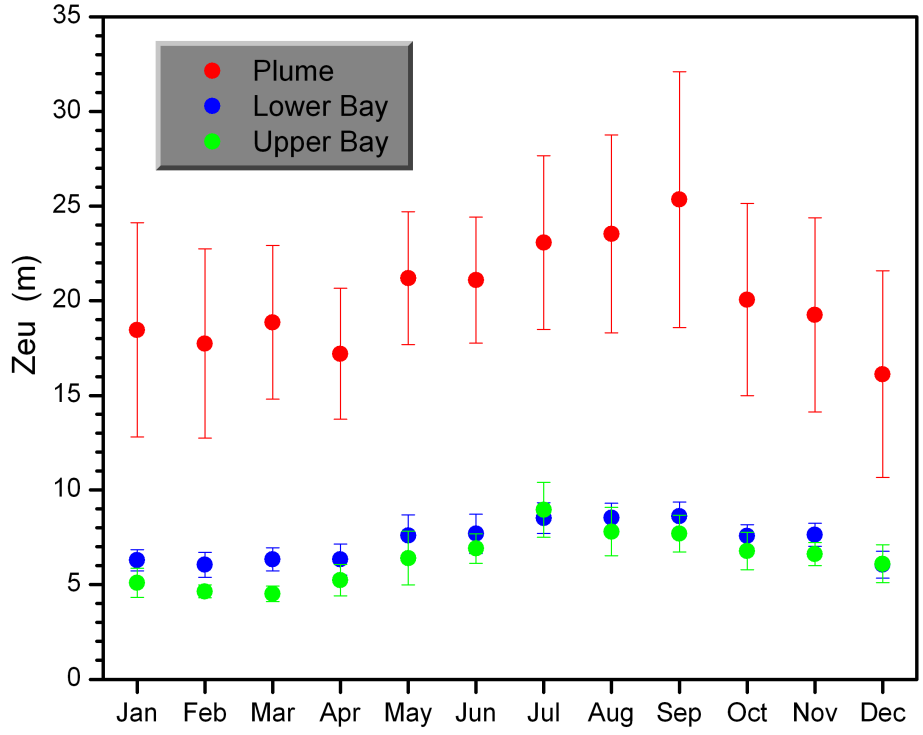
Monthly Composites (2005-2009), TSS



Time-Series Analysis – Within Bays

5-Year Monthly Averages (2005-2009), Mobile Bay





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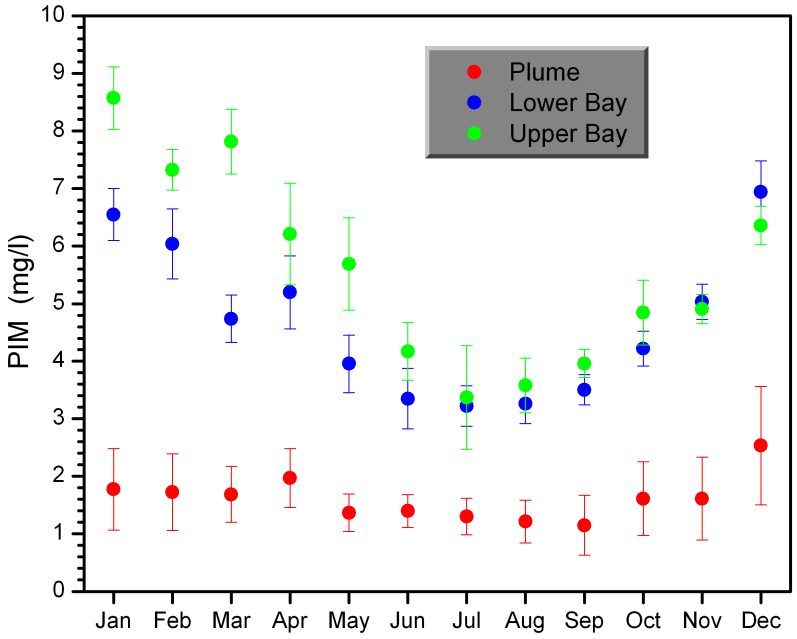

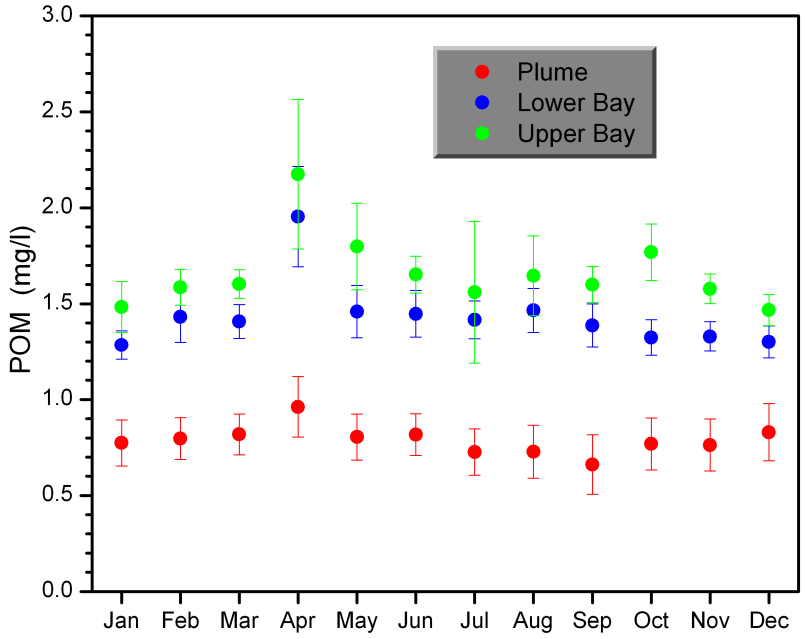

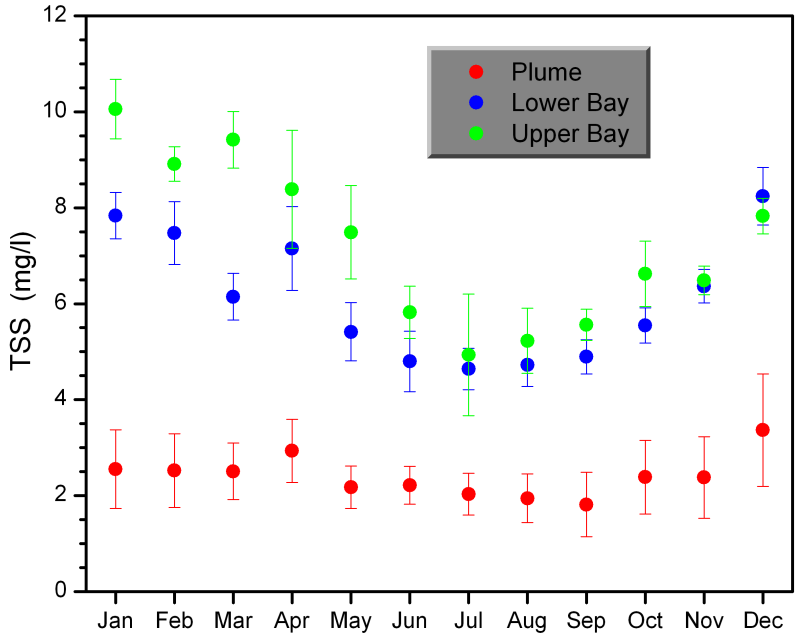

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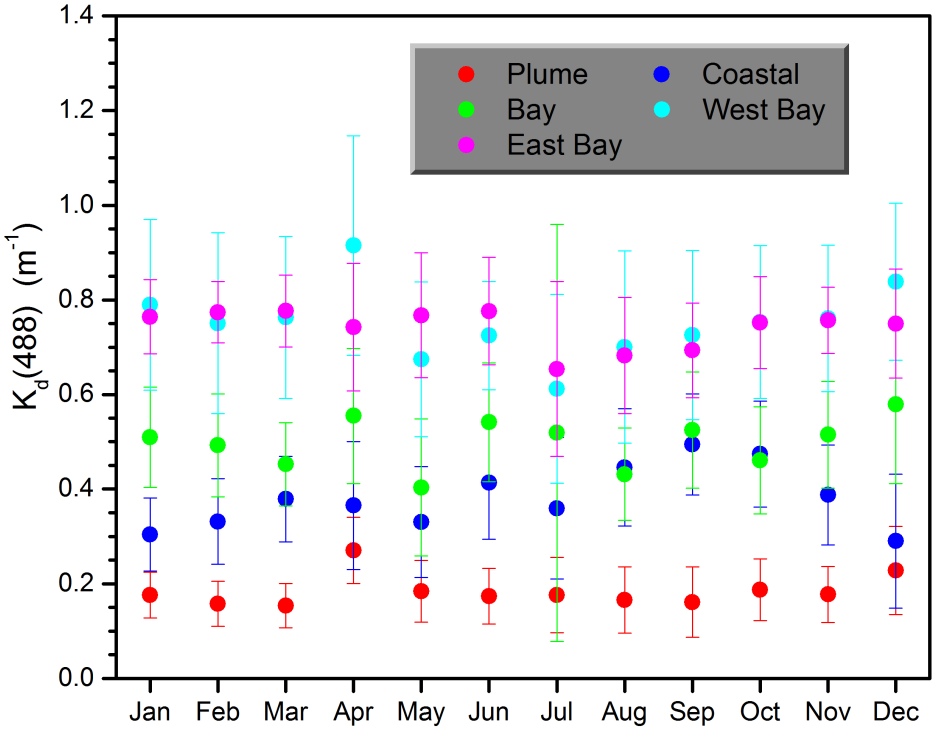
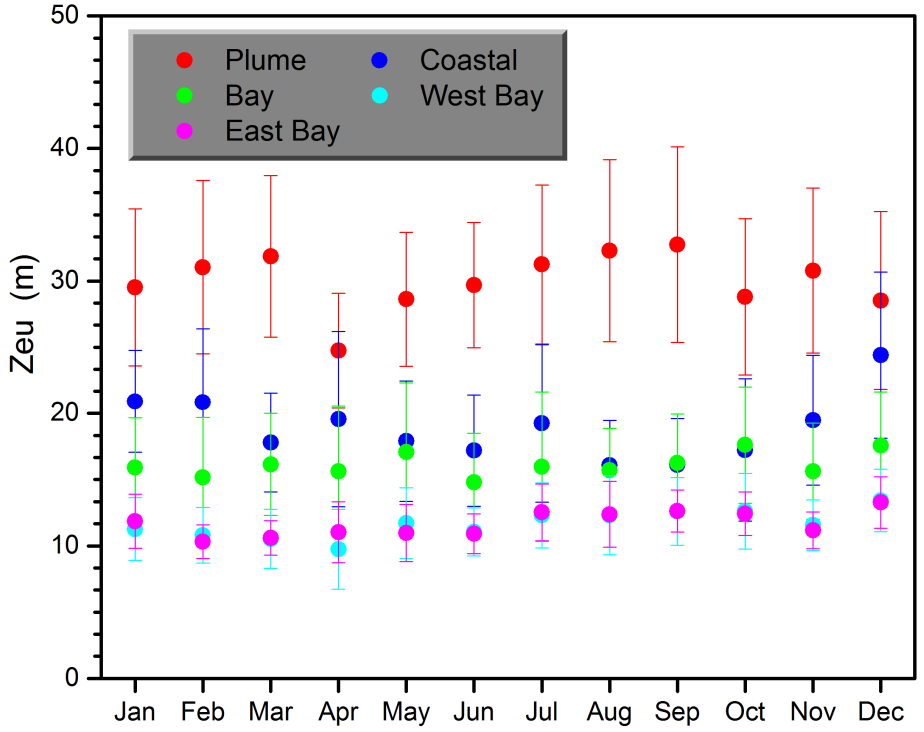
5-Year Monthly Averages (2005-2009), Pensacola Bay





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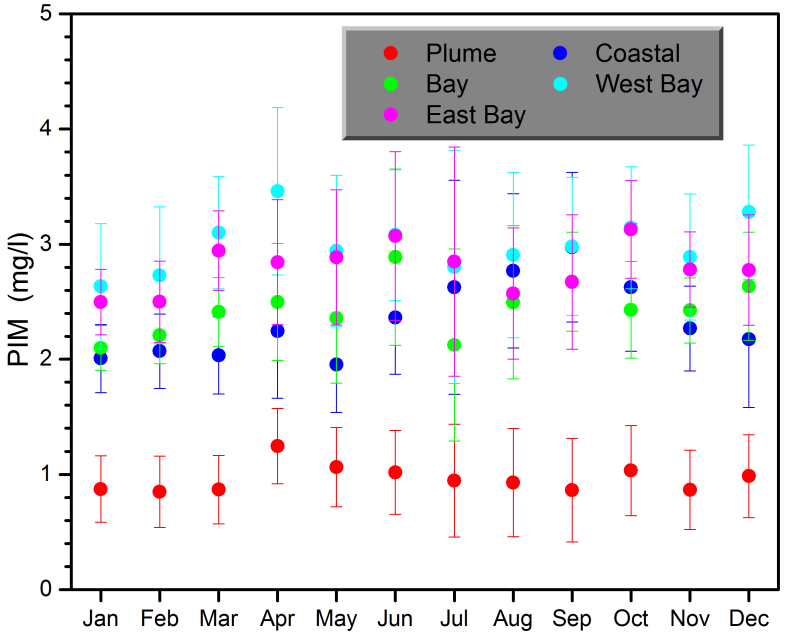
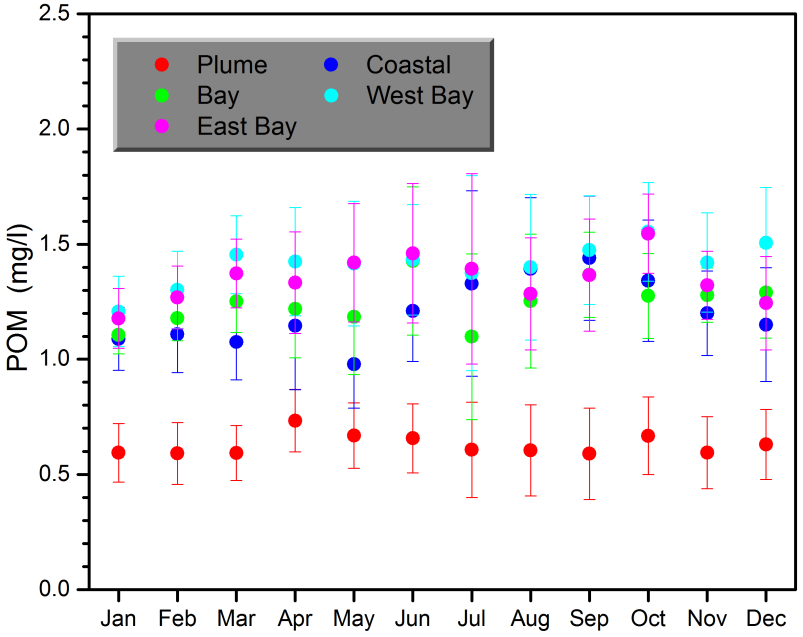
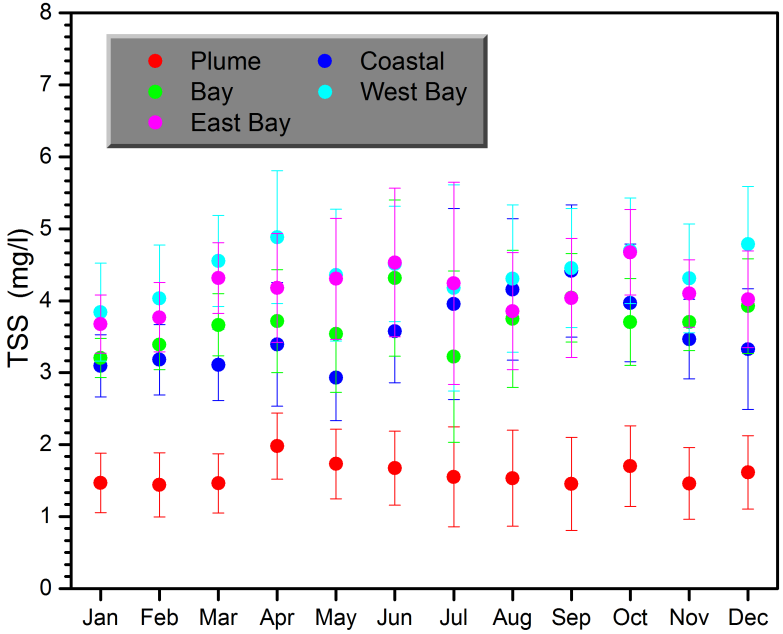
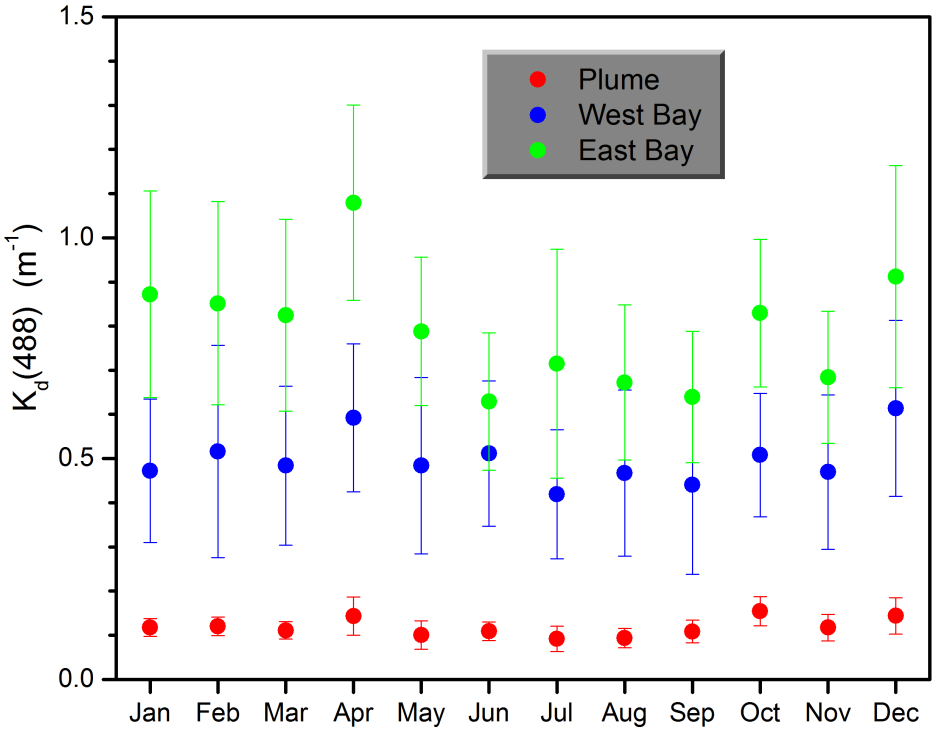


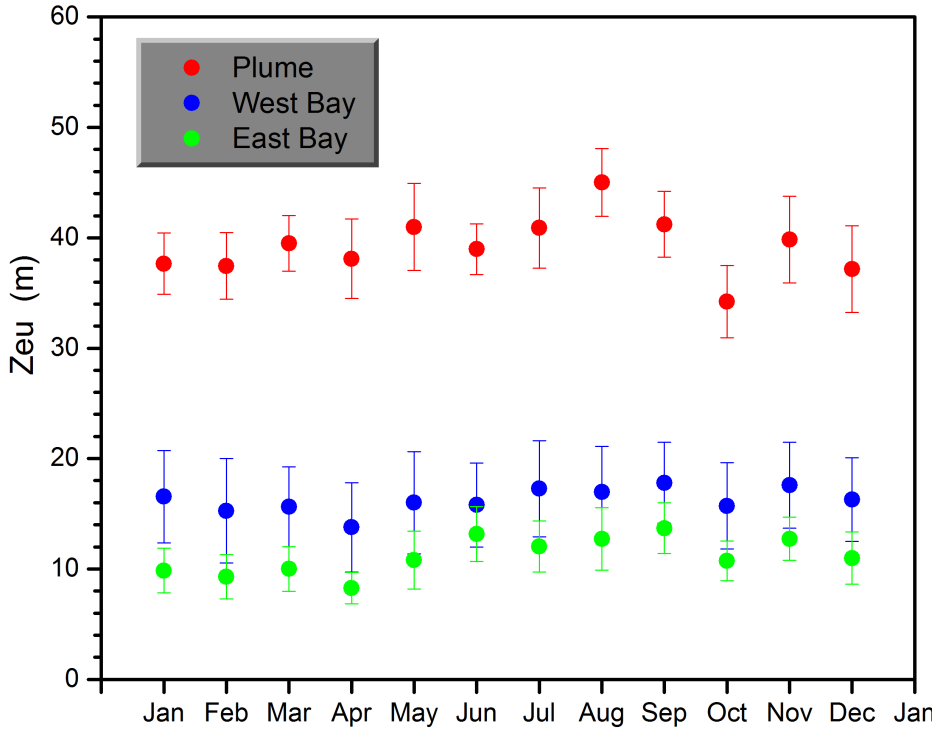




Time-Series Analysis – Within Bays

5-Year Monthly Averages (2005-2009), Choctawhatchee Bay





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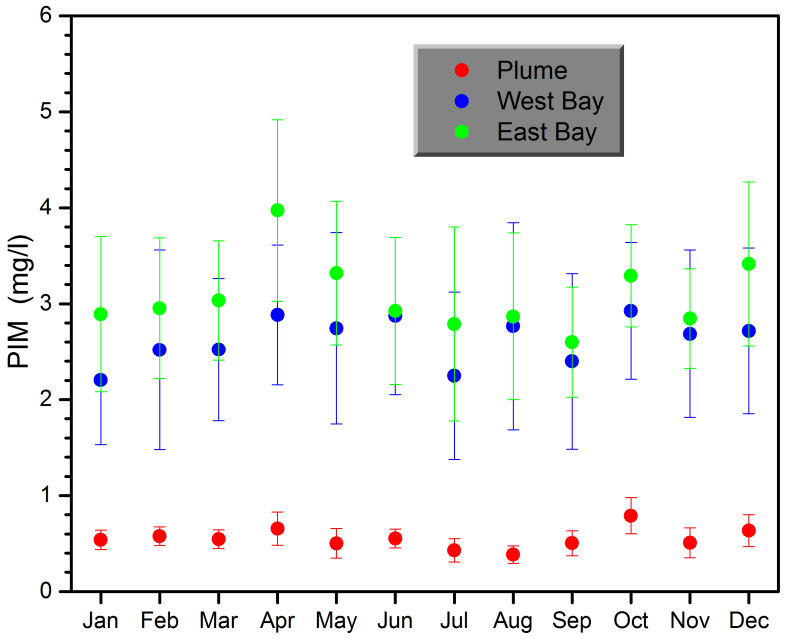
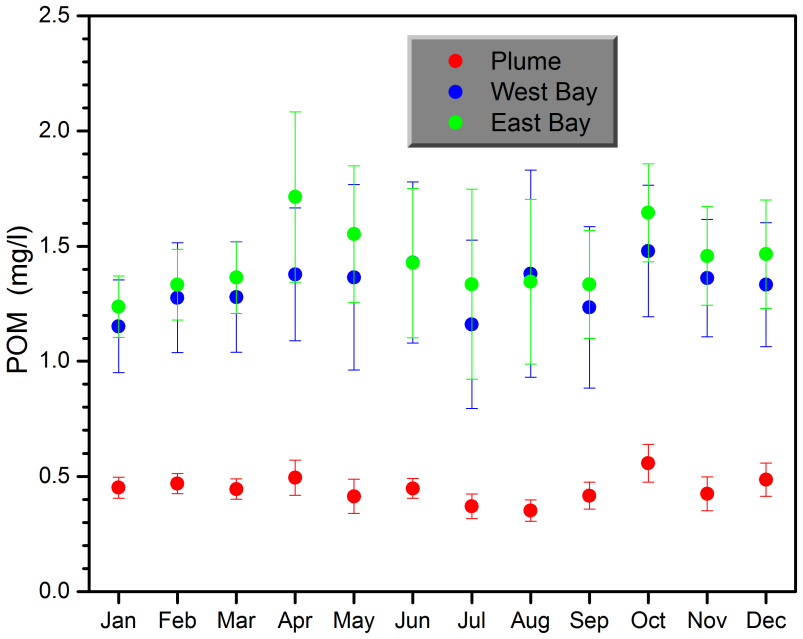
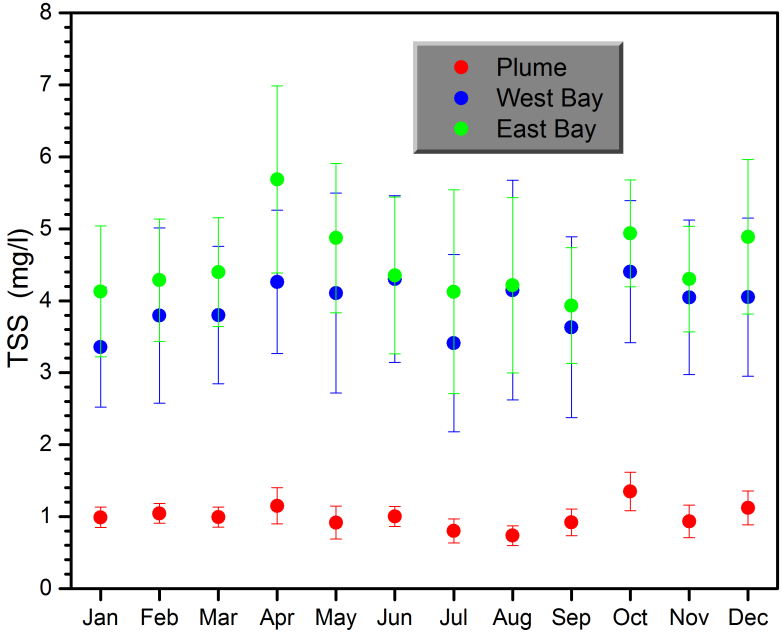
5-Year Monthly Averages (2005-2009), Choctawhatchee Bay

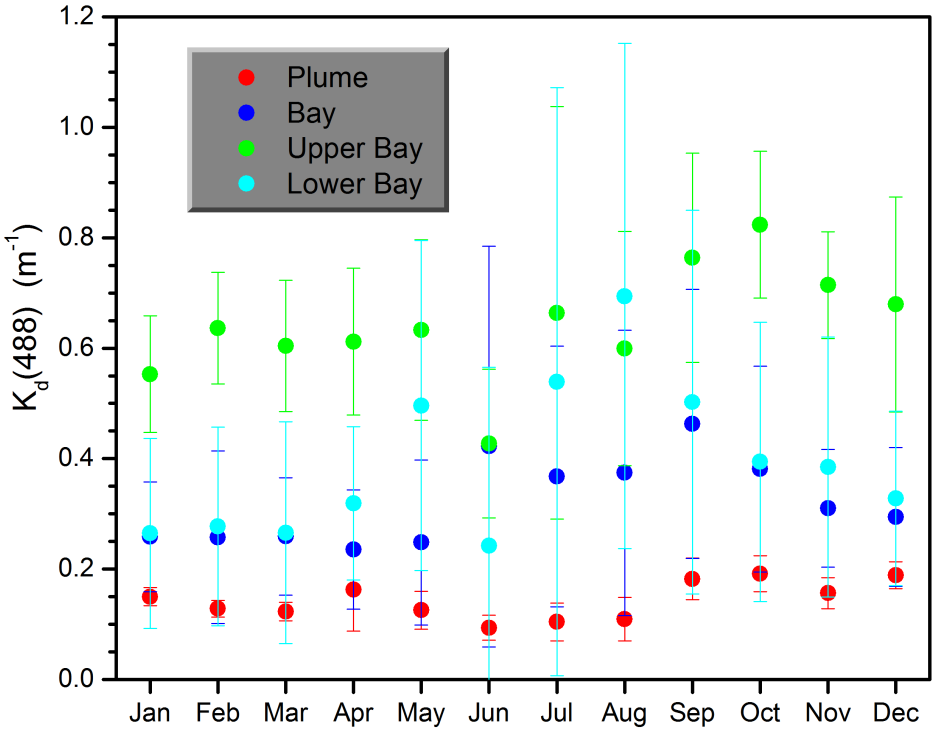


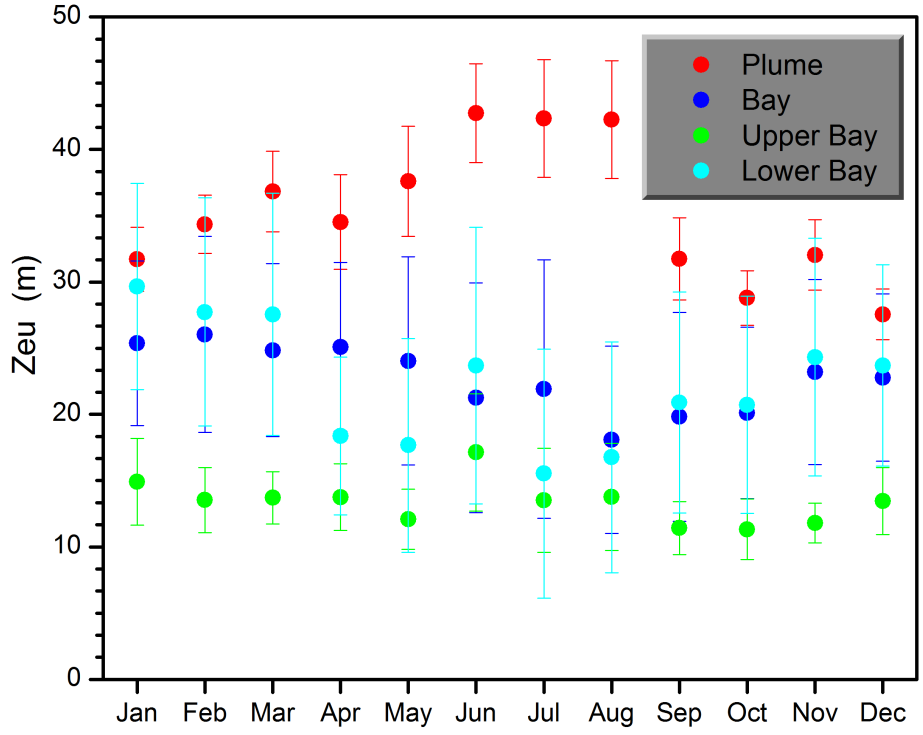




Time-Series Analysis – Within Bays

5-Year Monthly Averages (2005-2009), St. Andrew Bay





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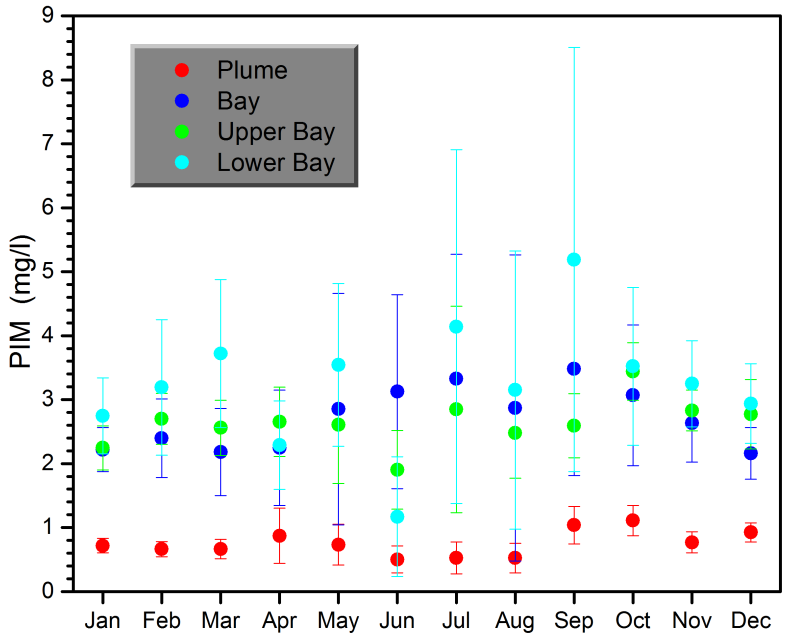
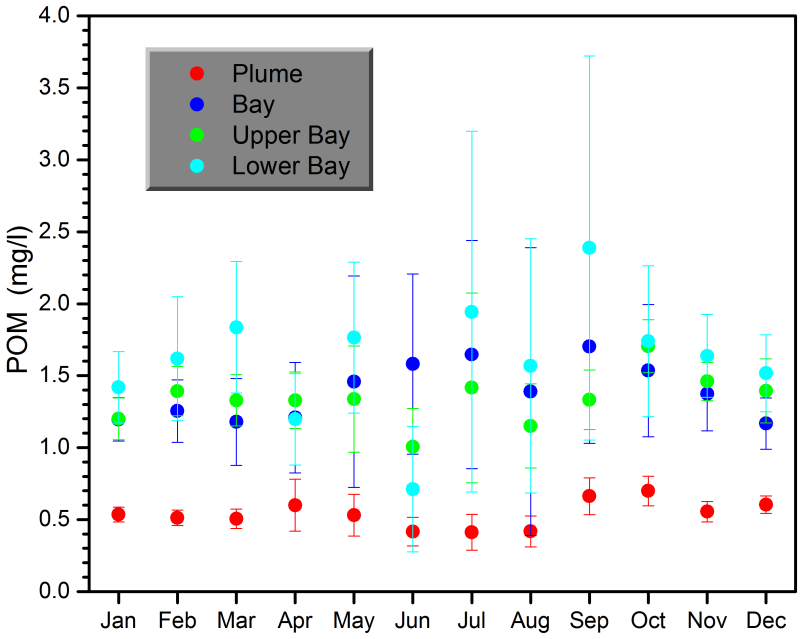
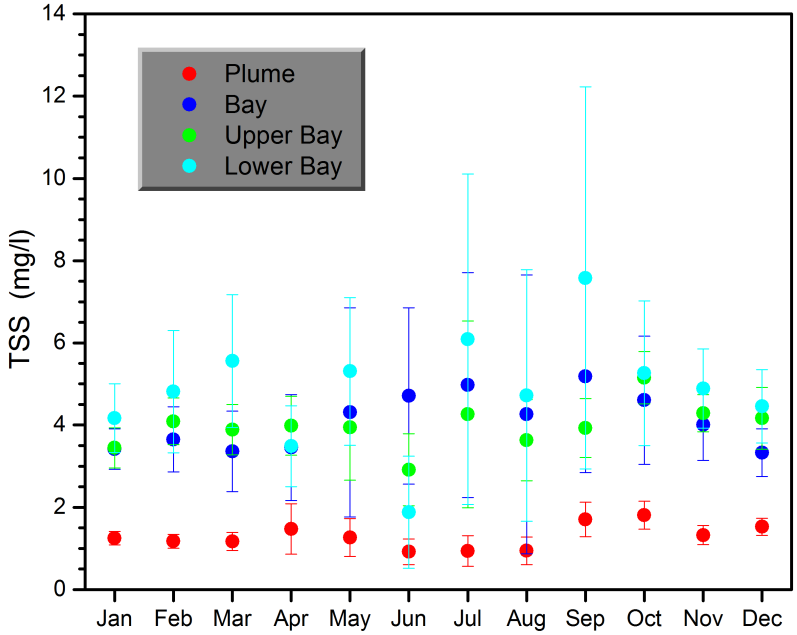
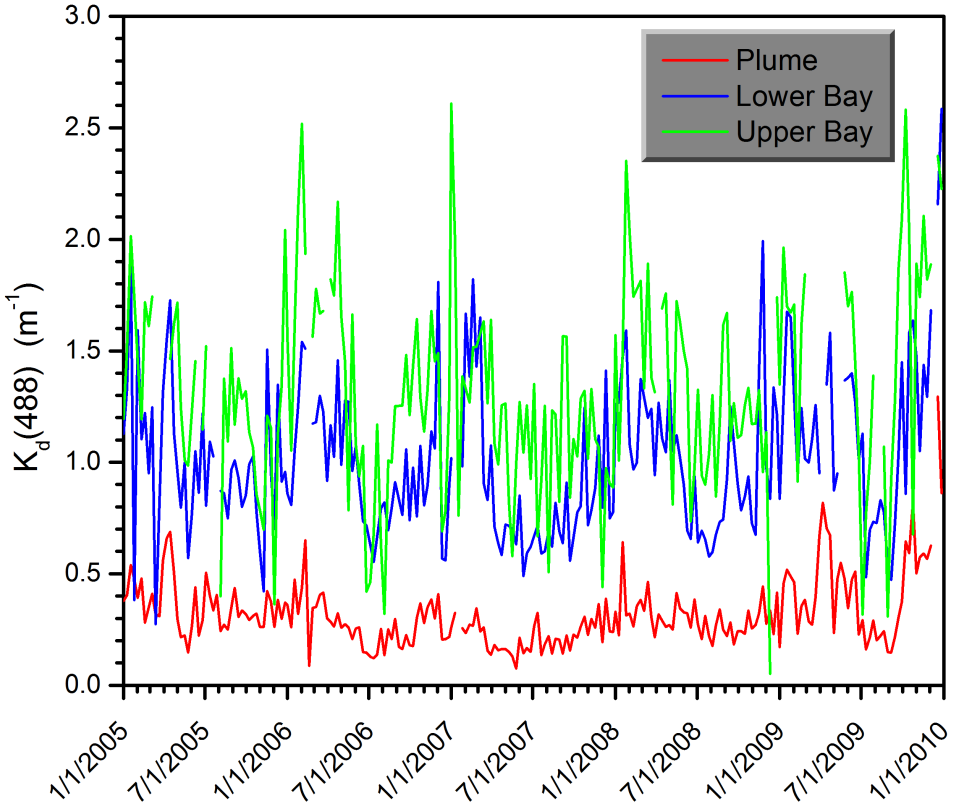


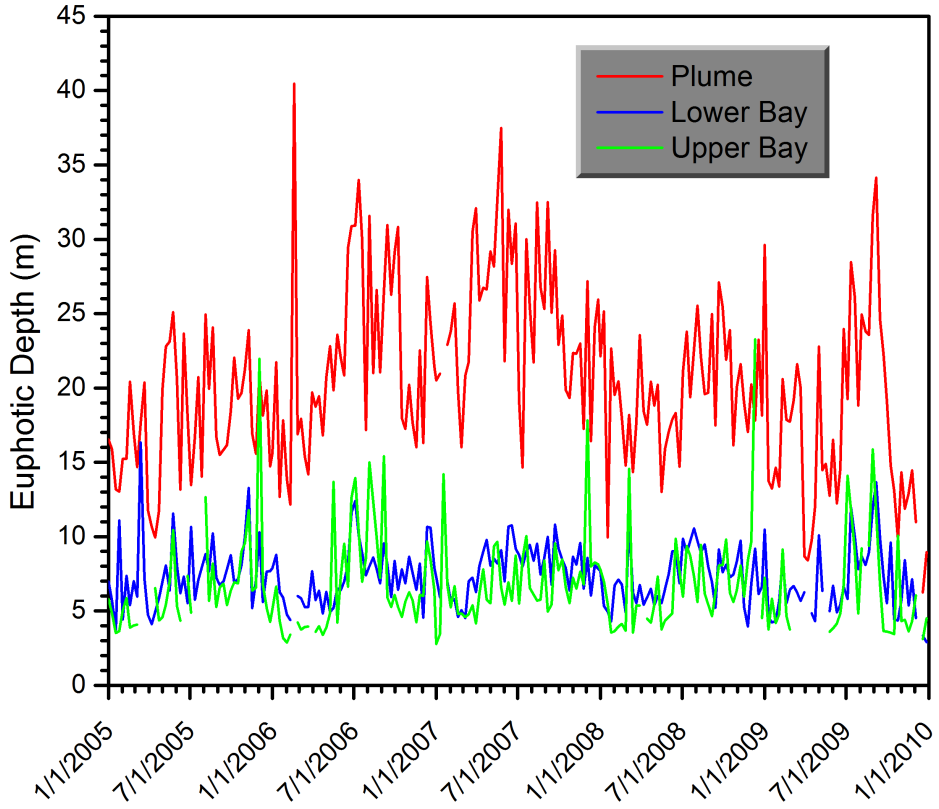




Time-Series Analysis – Within Bays

Weekly Averages For 5 Years (1/1/05-12/31/09), Mobile Bay





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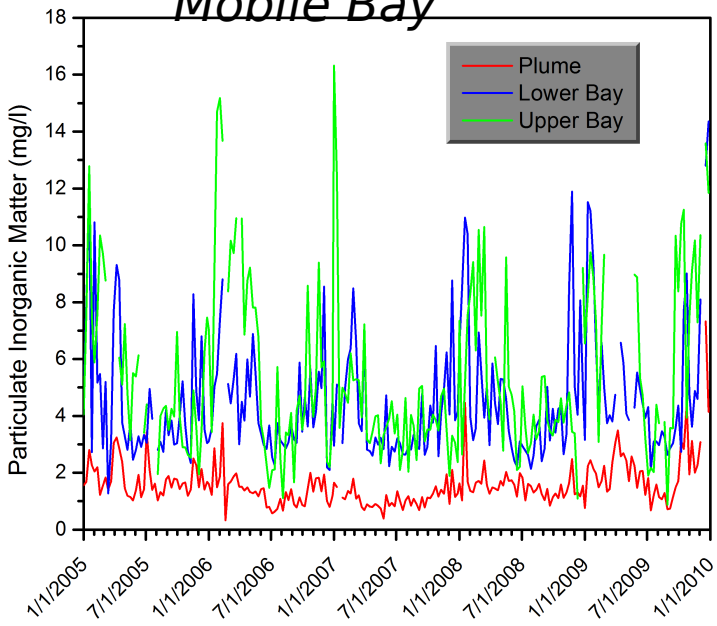

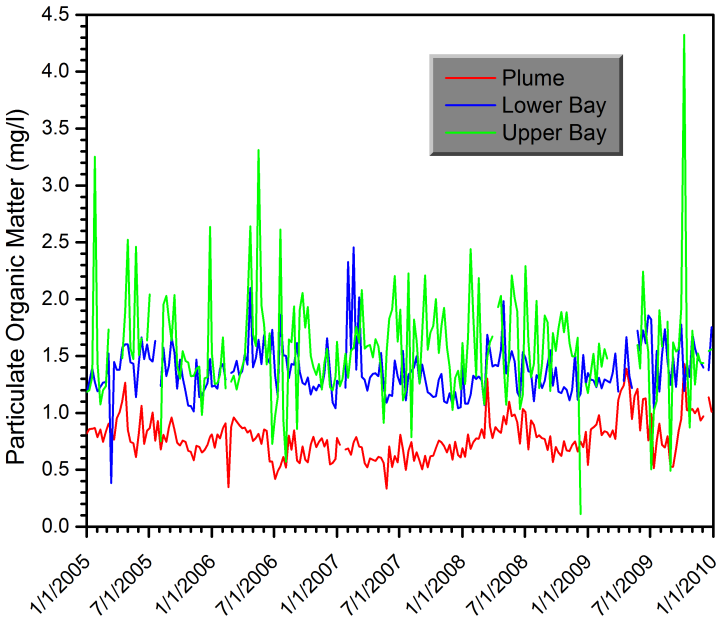

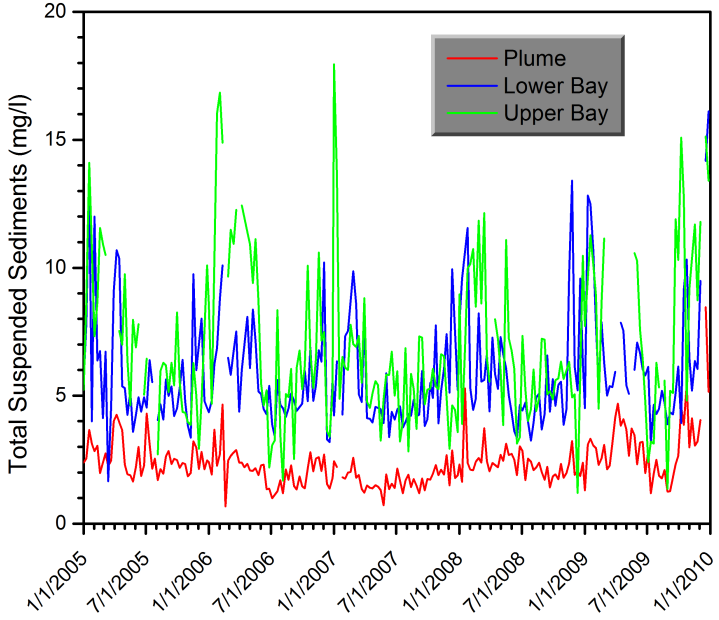

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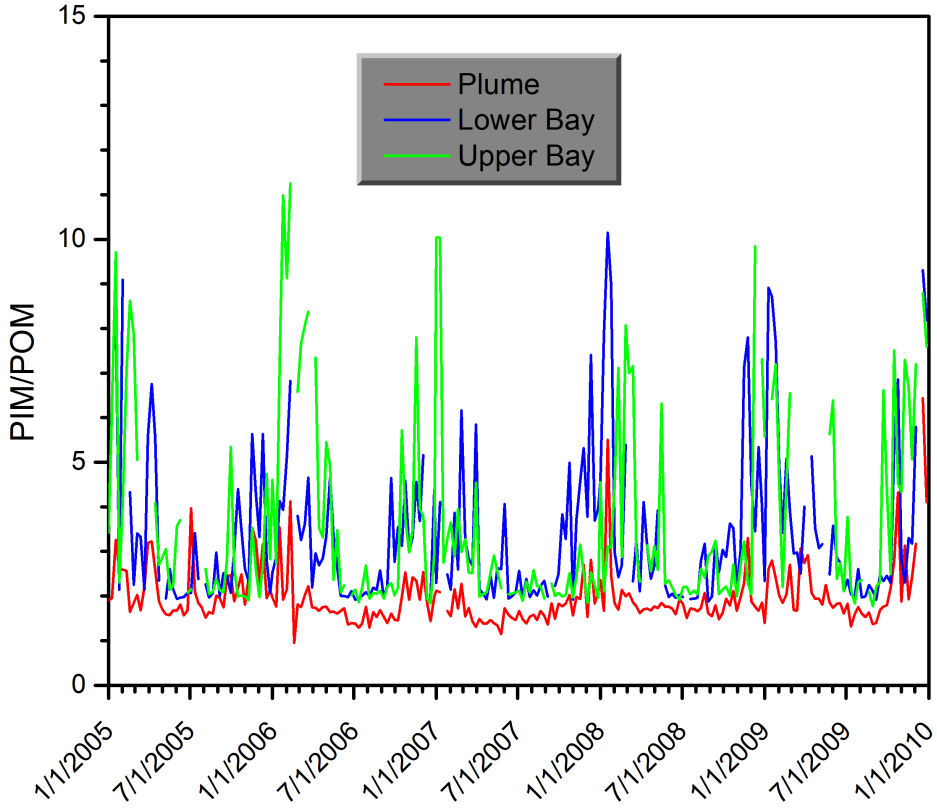
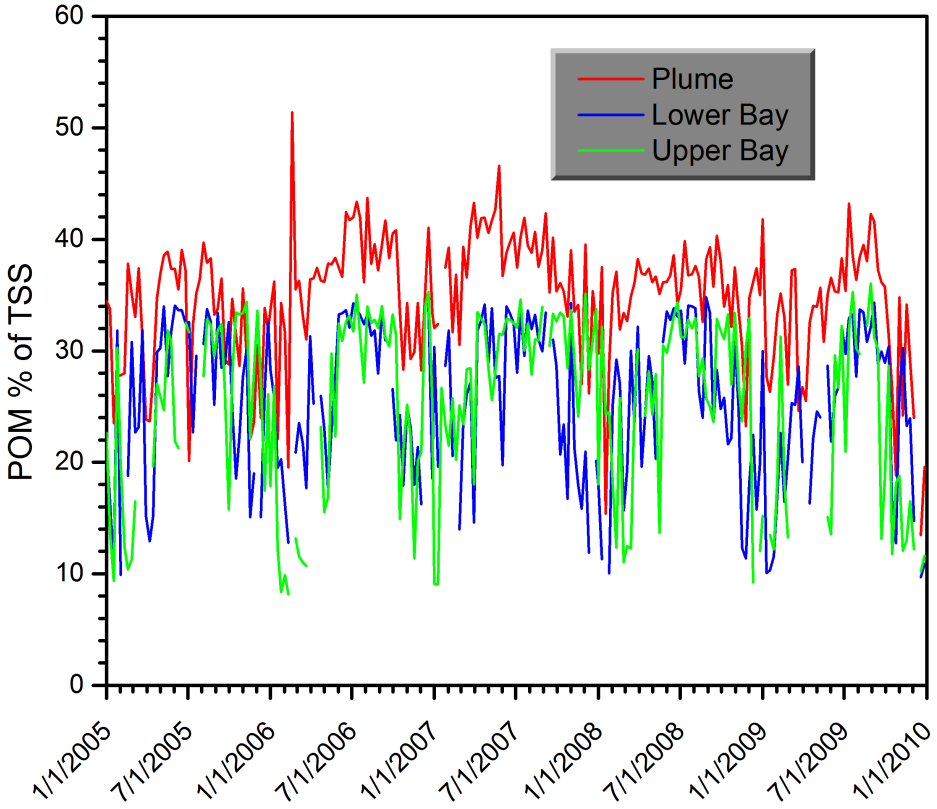
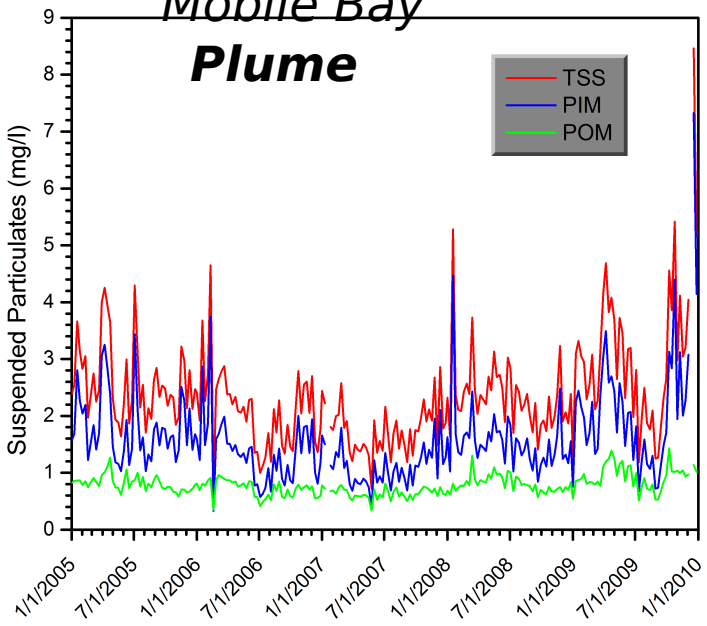
Weekly Averages For 5 Years (1/1/05-12/31/09), Mobile Bay

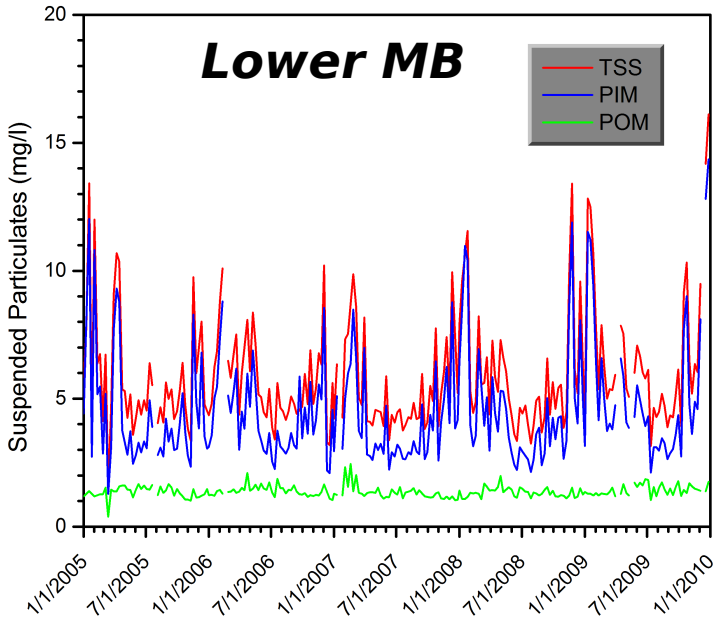


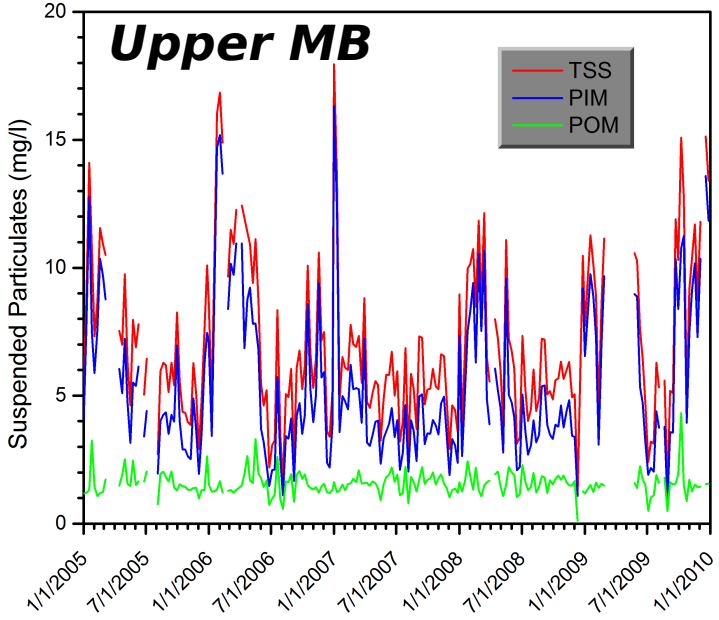


Time-Series Analysis – Within Bays

Weekly Averages For 5 Years (1/1/05-12/31/09), Mobile Bay

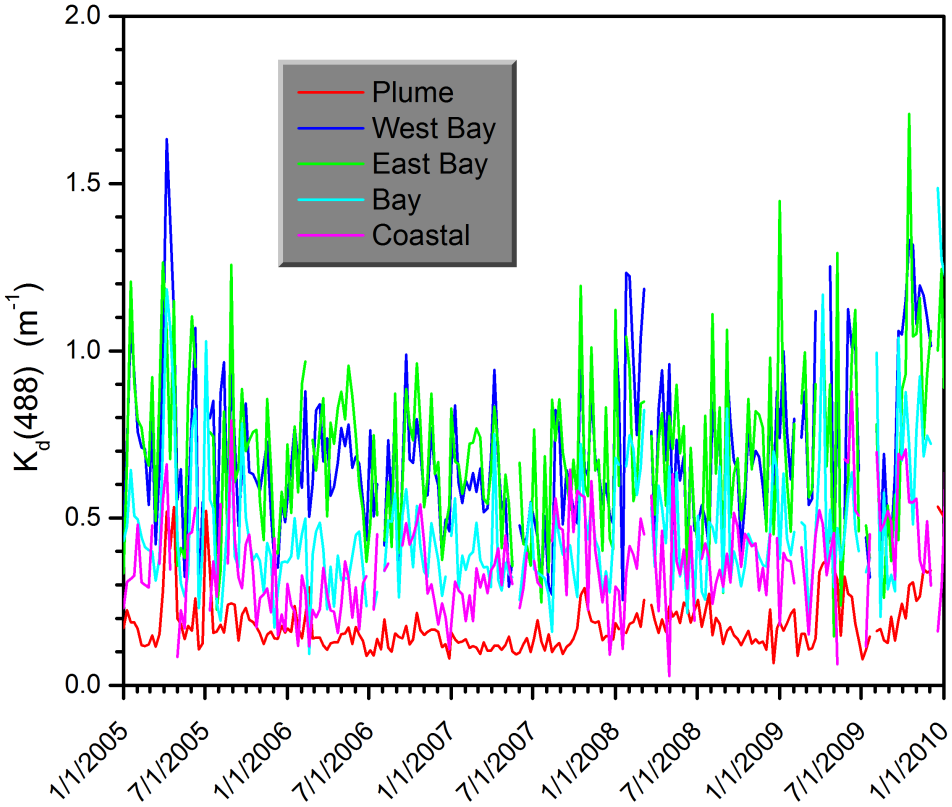


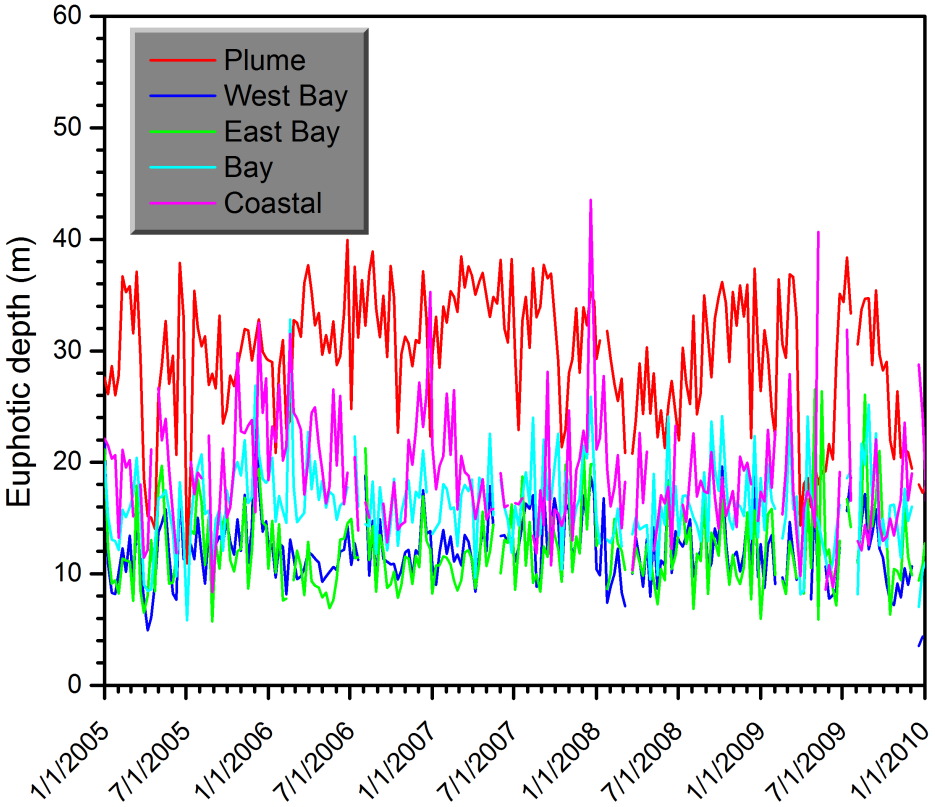




Time-Series Analysis – Within Bays

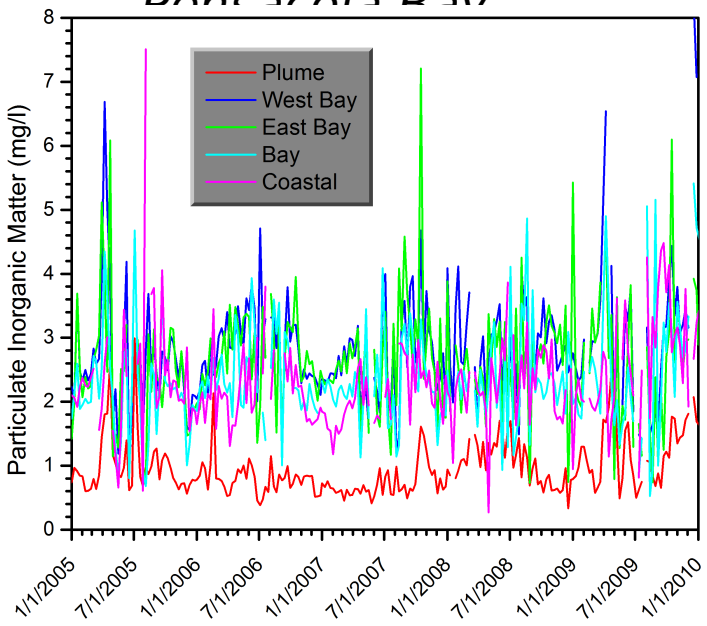
Weekly Averages For 5 Years (1/1/05-12/31/09), Pensacola Bay

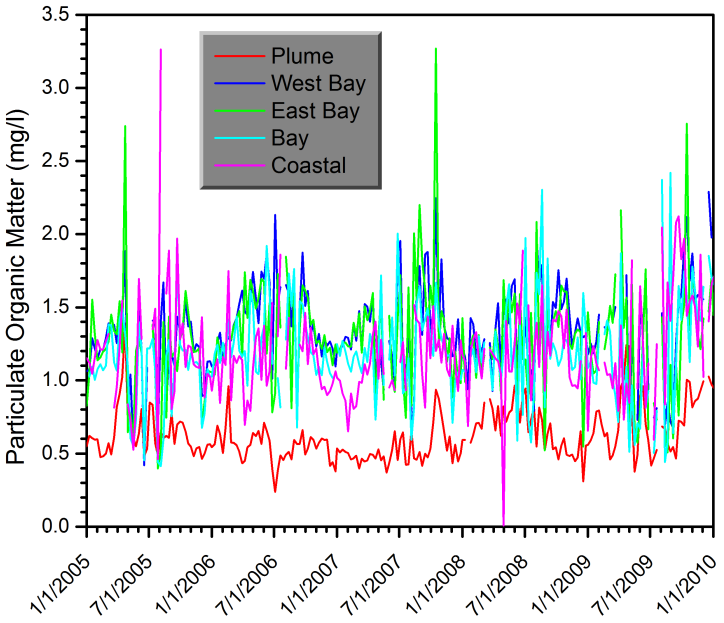


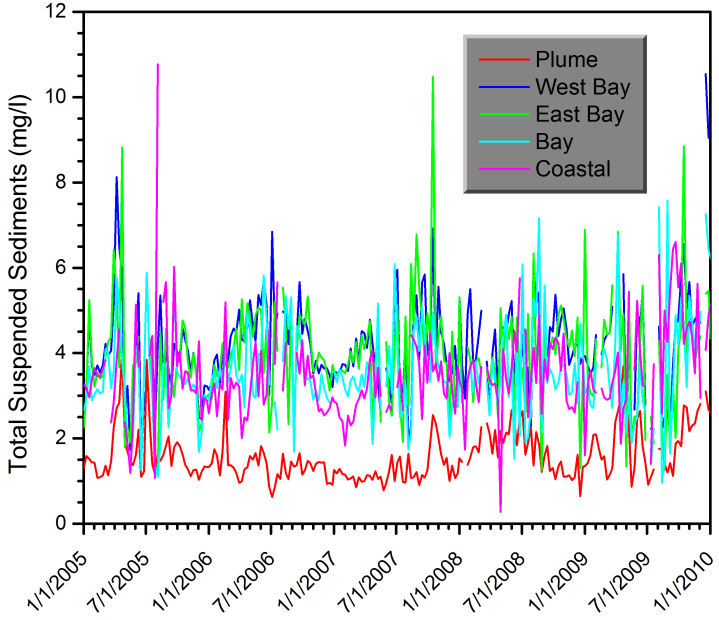


Time-Series Analysis – Within Bays

Weekly Averages For 5 Years (1/1/05-12/31/09), Pensacola Bay

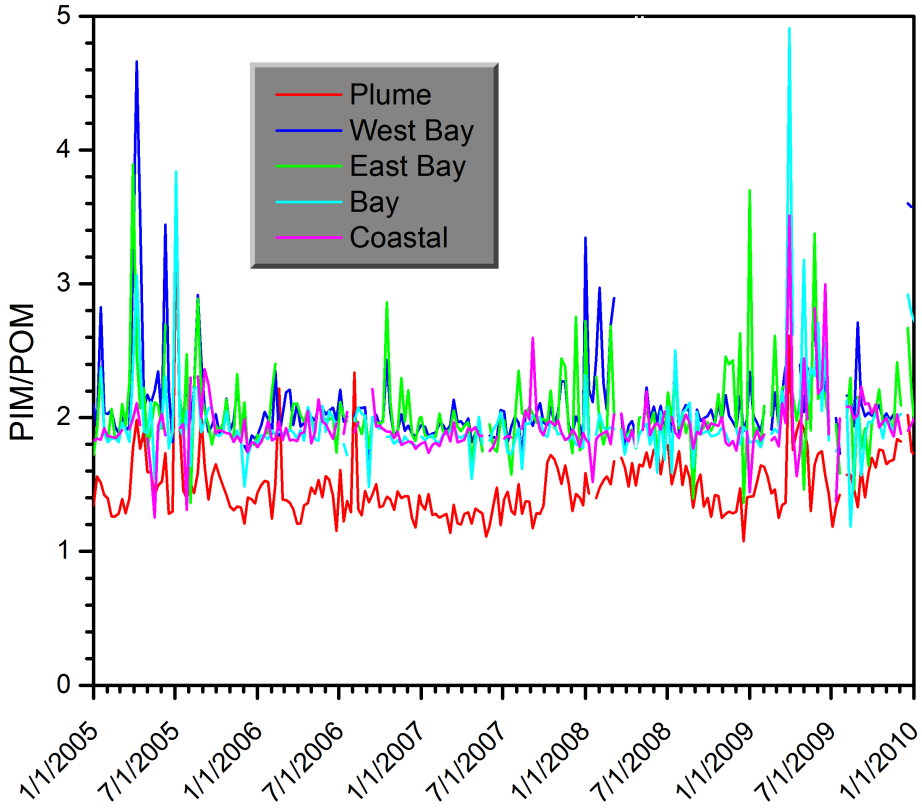


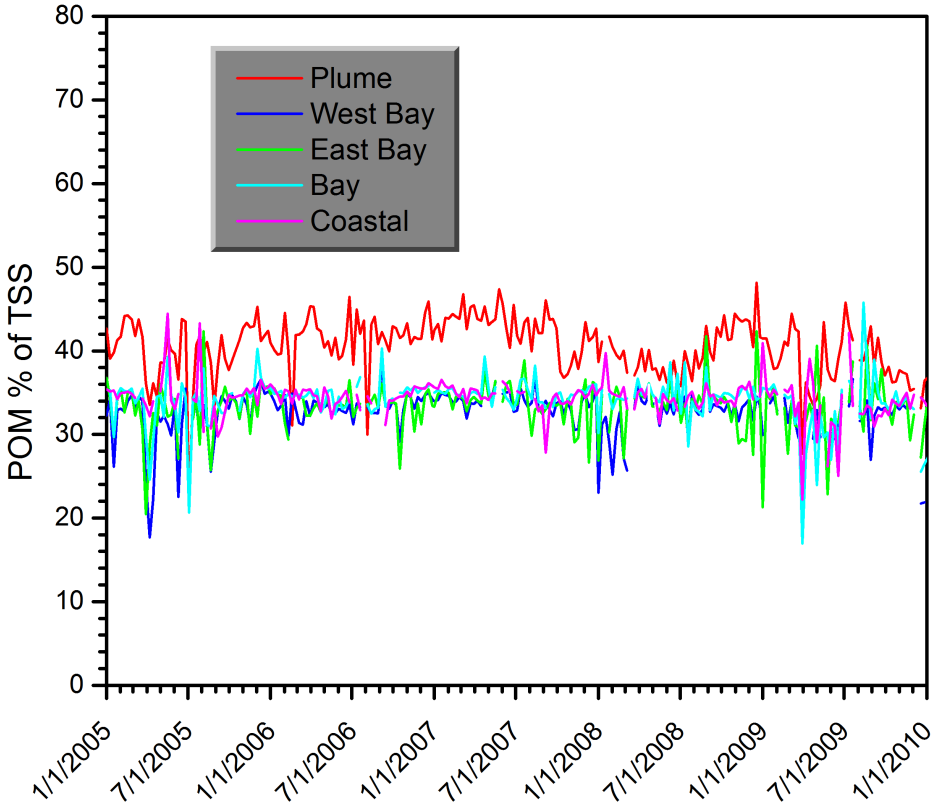




Time-Series Analysis – Within Bays

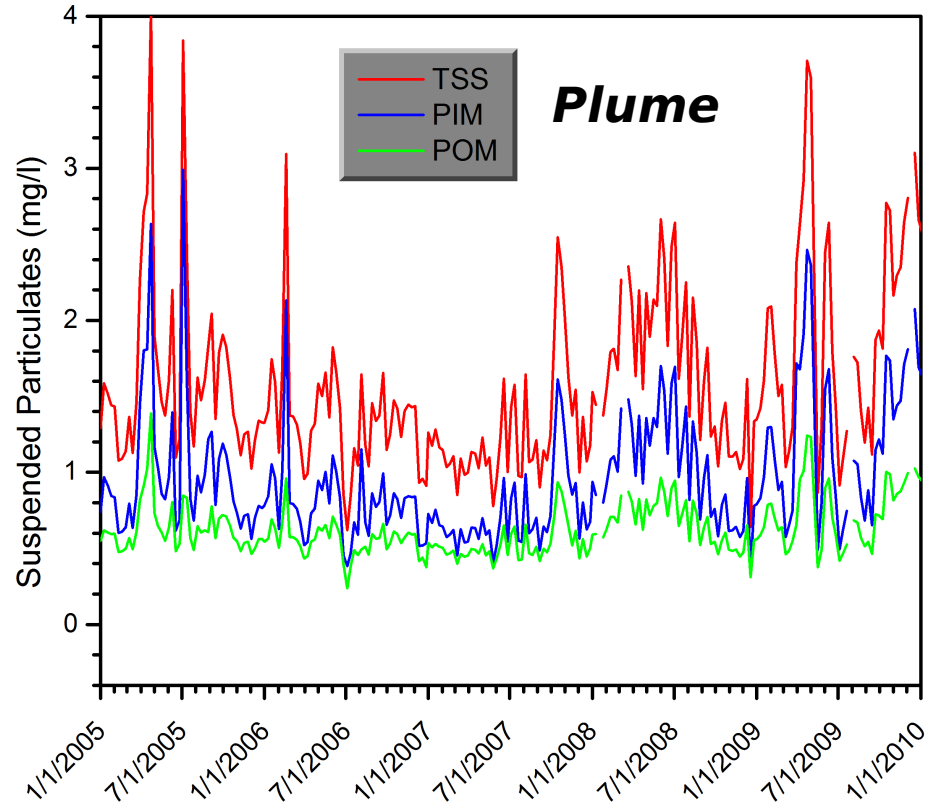
Weekly Averages For 5 Years (1/1/05-12/31/09), Pensacola Bay

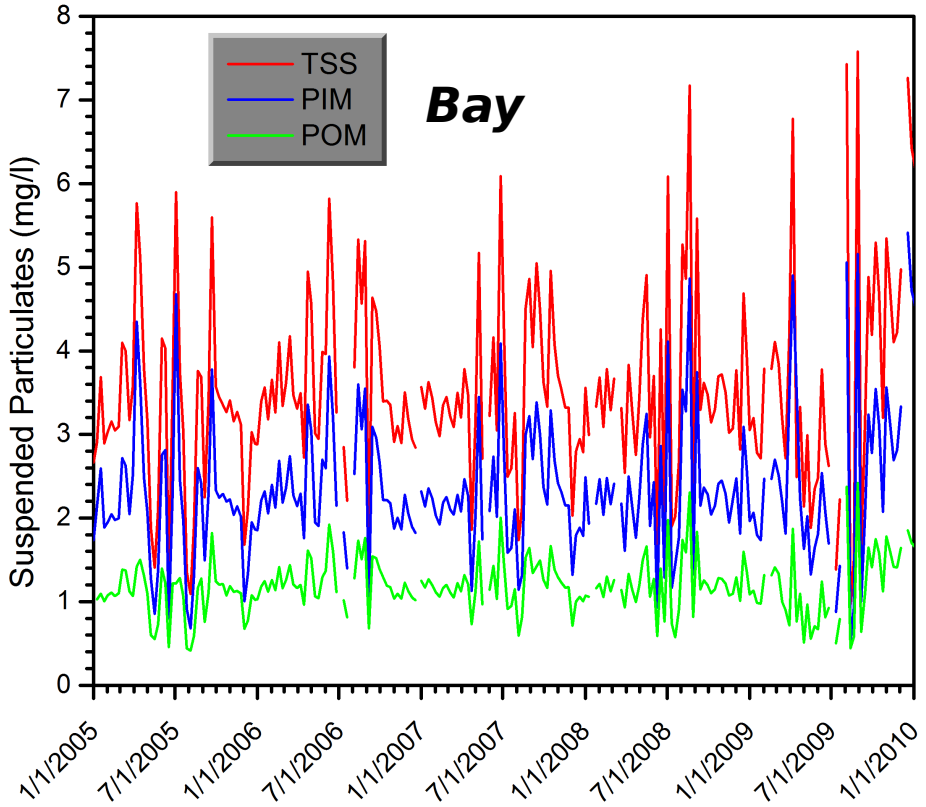




Time-Series Analysis – Within Bays

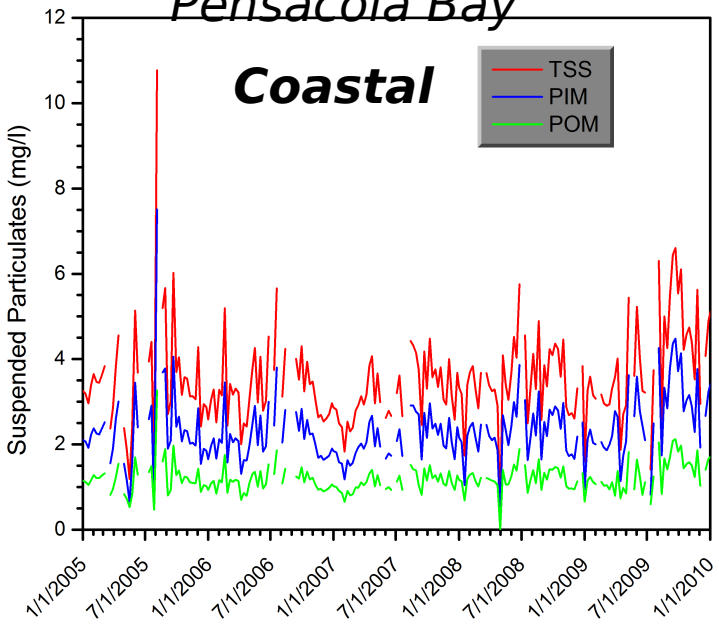
Weekly Averages For 5 Years (1/1/05-12/31/09), Pensacola Bay

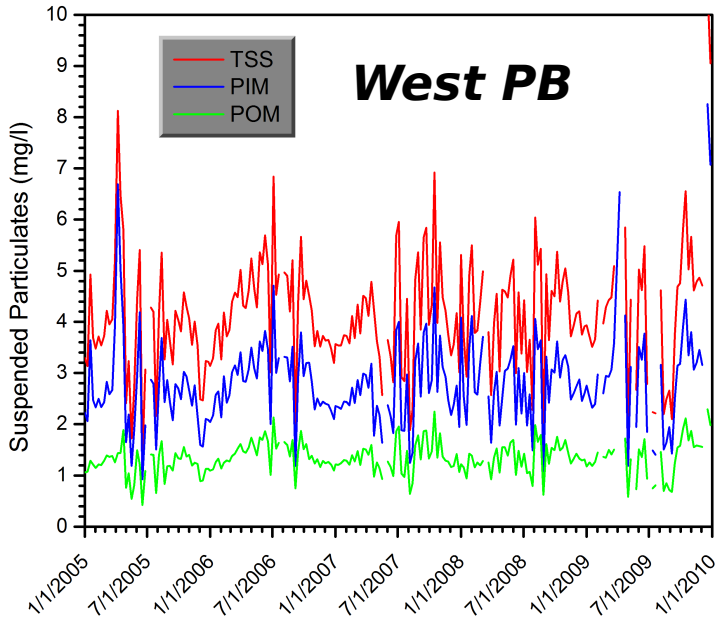


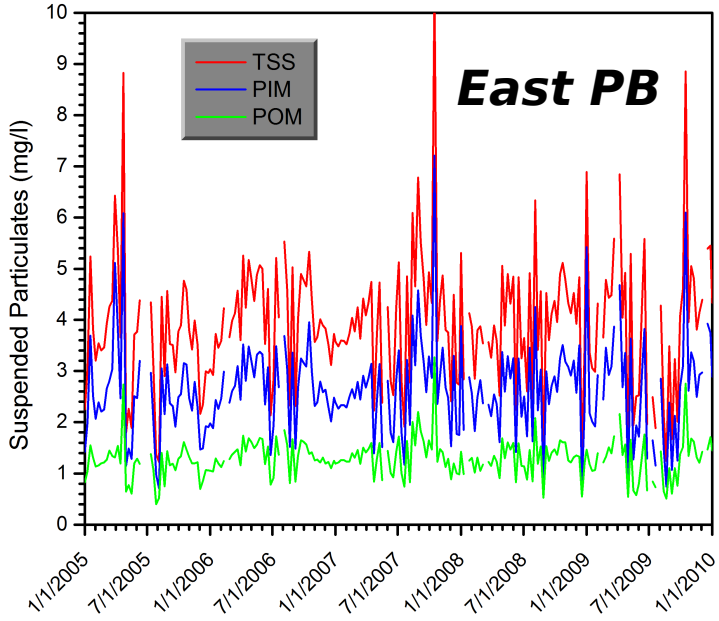


Time-Series Analysis – Within Bays

Weekly Averages For 5 Years (1/1/05-12/31/09), Pensacola Bay

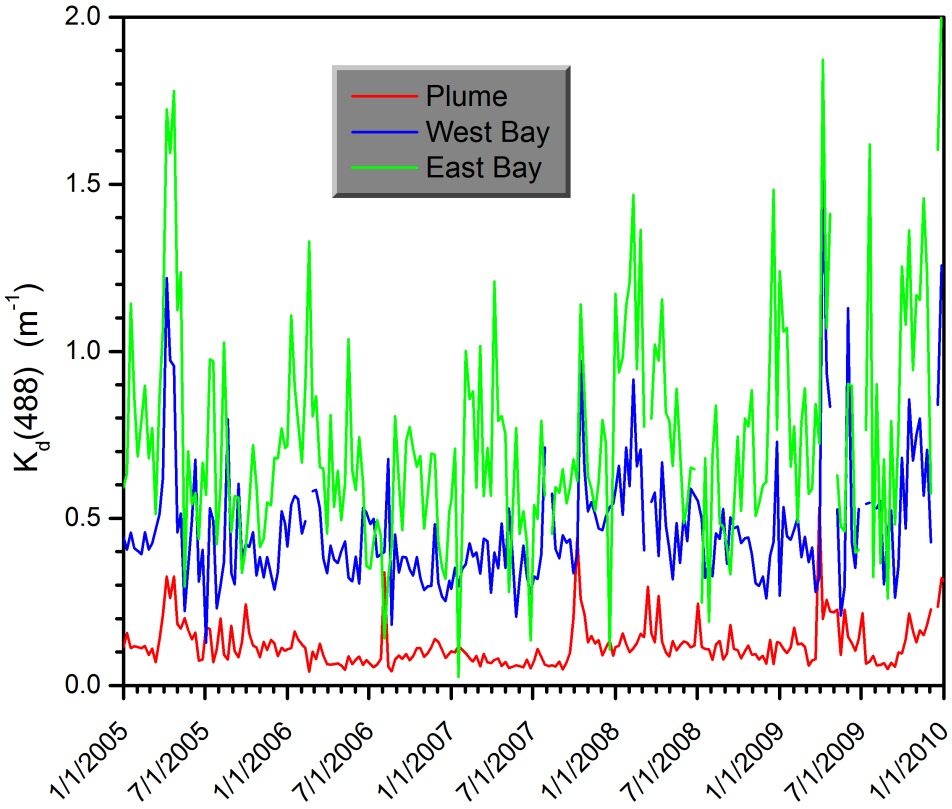


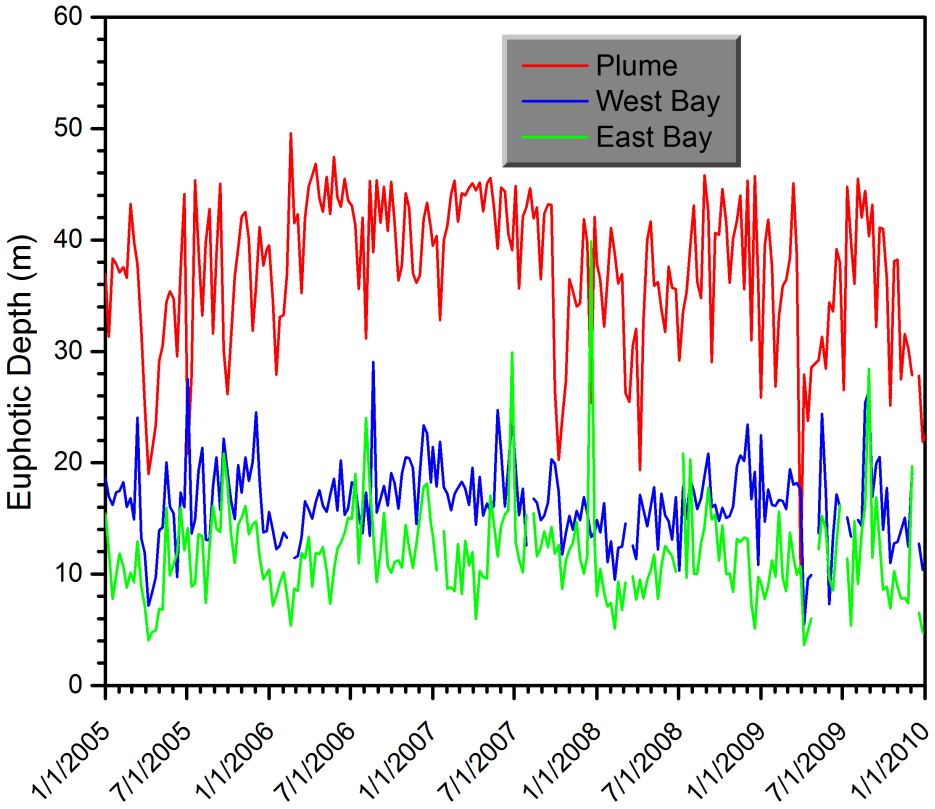




Time-Series Analysis – Within Bays

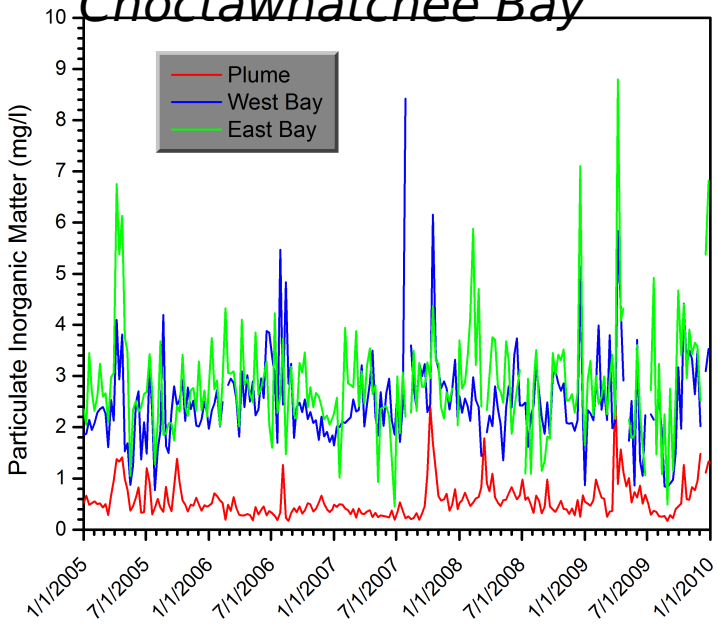
Weekly Averages For 5 Years (1/1/05-12/31/09), Choctawhatchee Bay

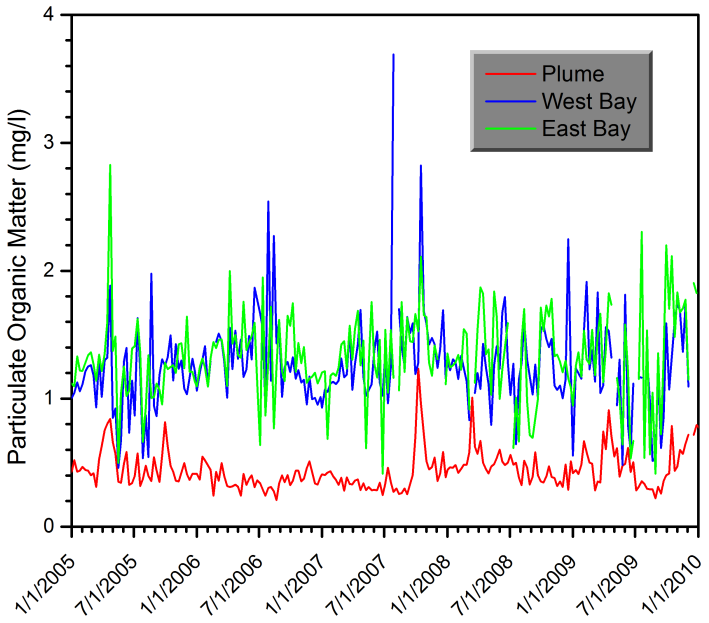


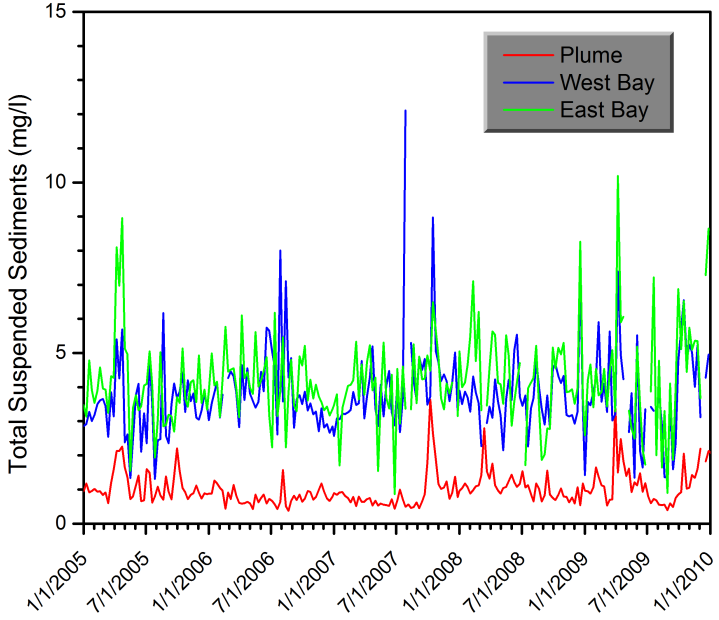


Time-Series Analysis – Within Bays

Weekly Averages For 5 Years (1/1/05-12/31/09), Choctawhatchee Bay

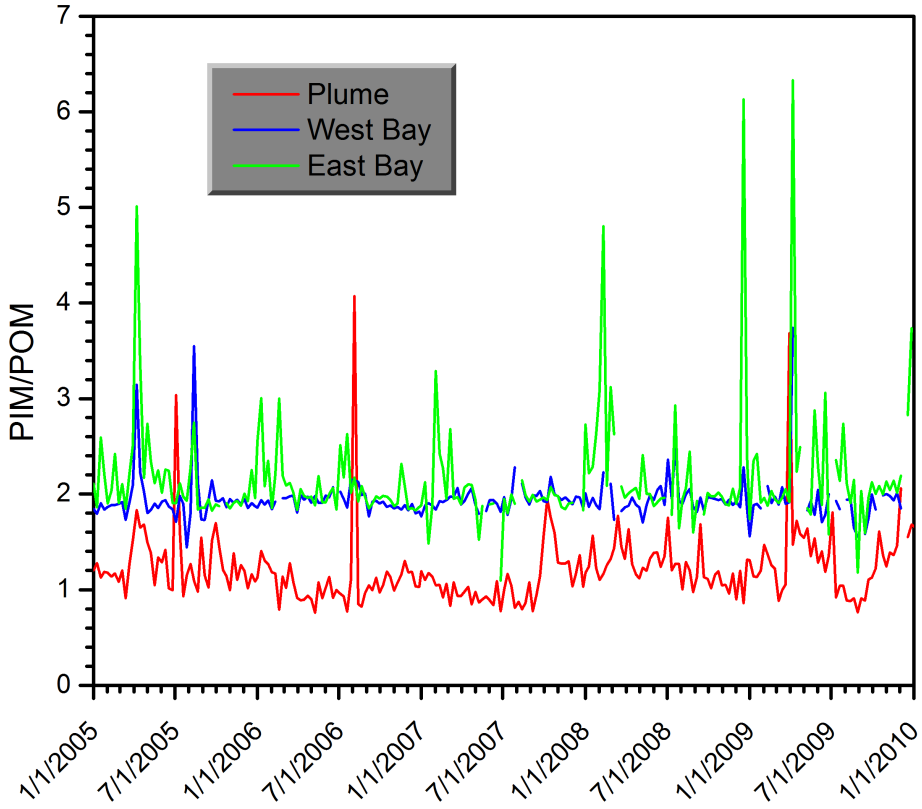


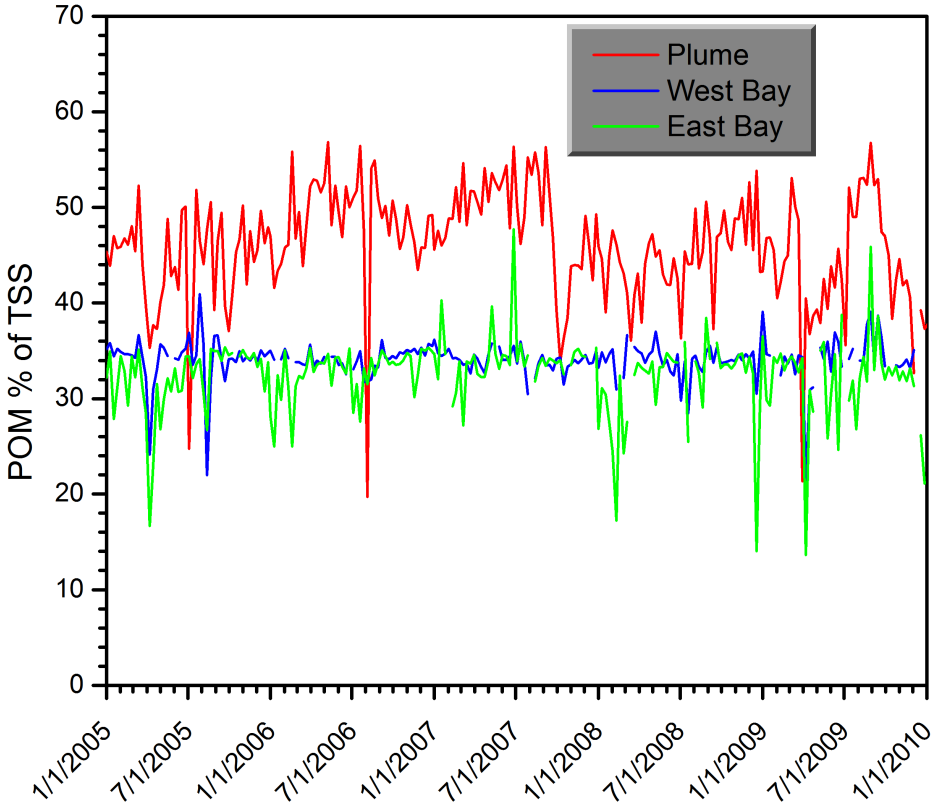




Time-Series Analysis – Within Bays

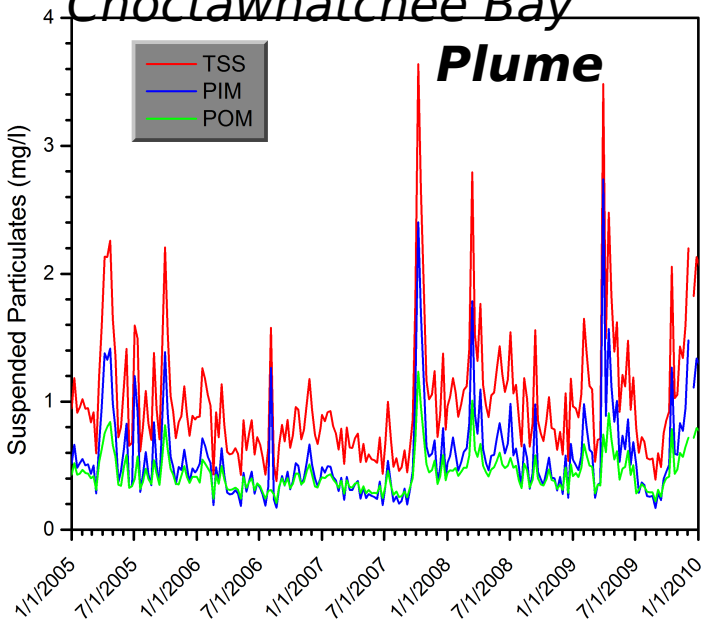
Weekly Averages For 5 Years (1/1/05-12/31/09), Choctawhatchee Bay

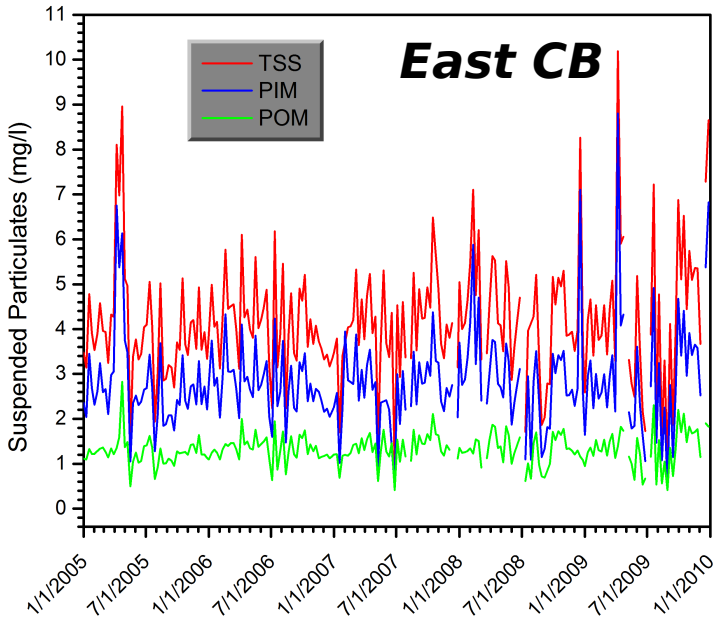


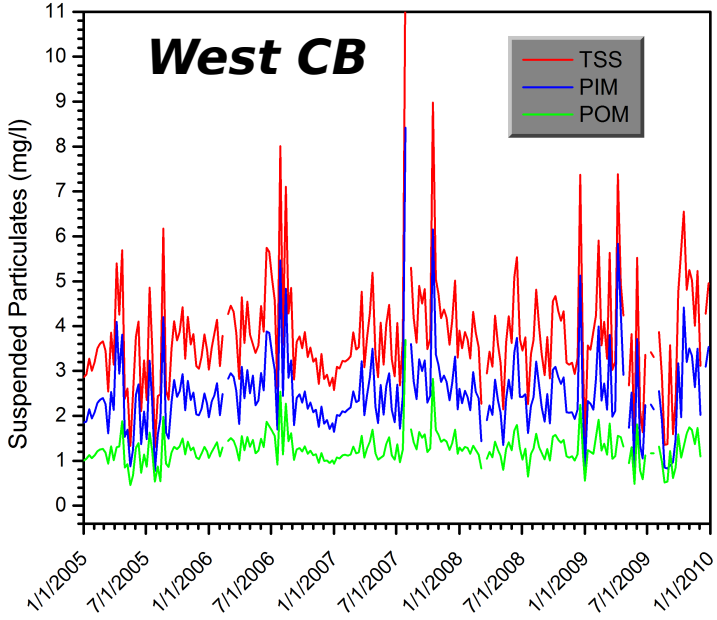


Time-Series Analysis – Within Bays

Weekly Averages For 5 Years (1/1/05-12/31/09), Choctawhatchee Bay

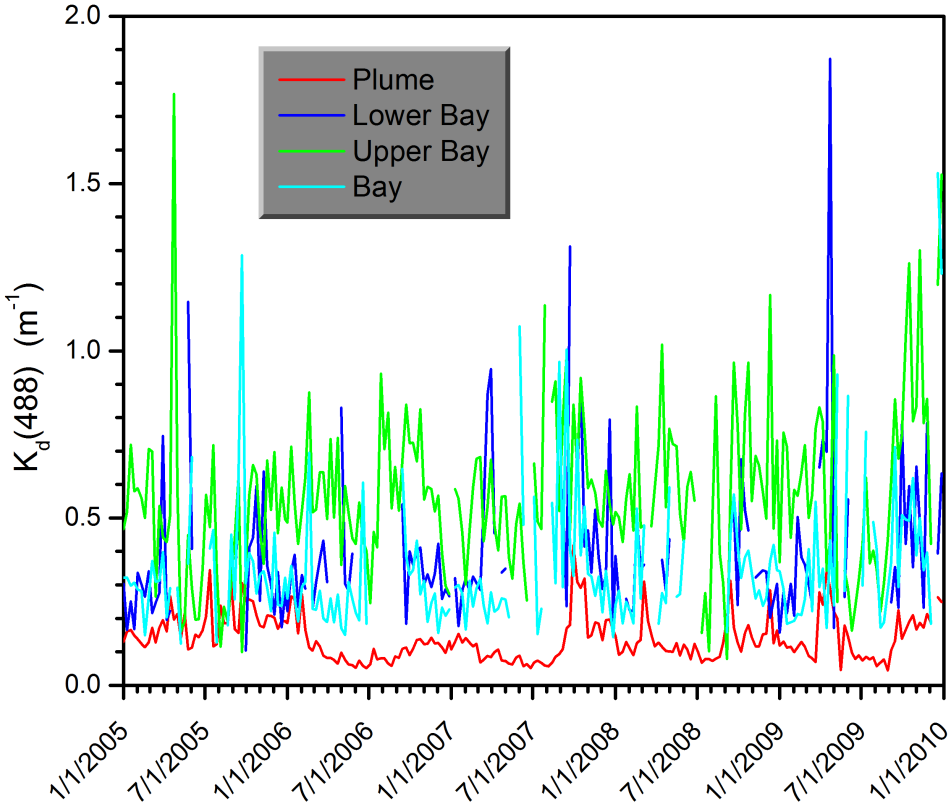


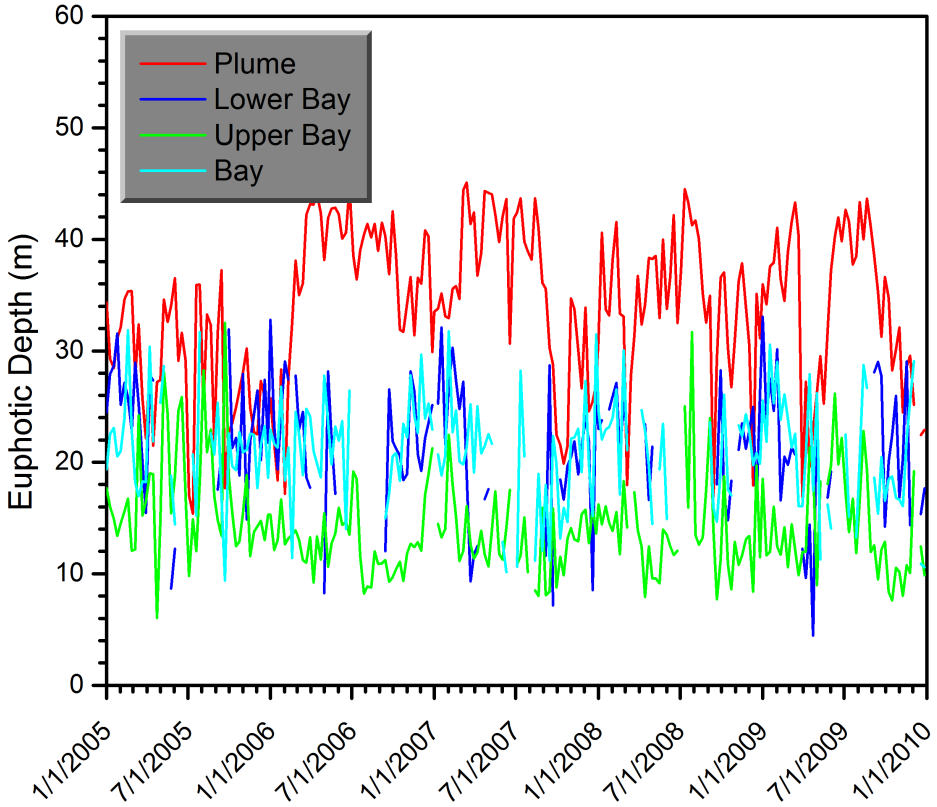




Time-Series Analysis – Within Bays

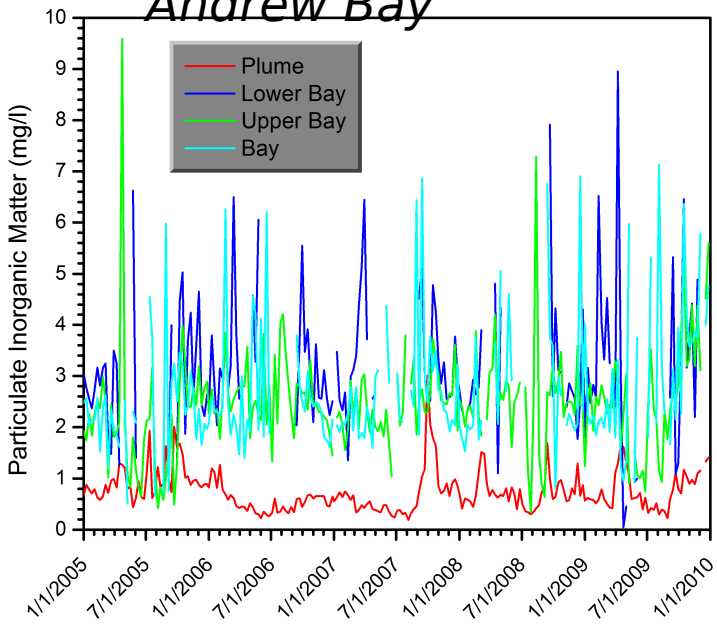
Weekly Averages For 5 Years (1/1/05-12/31/09), St. Andrew Bay

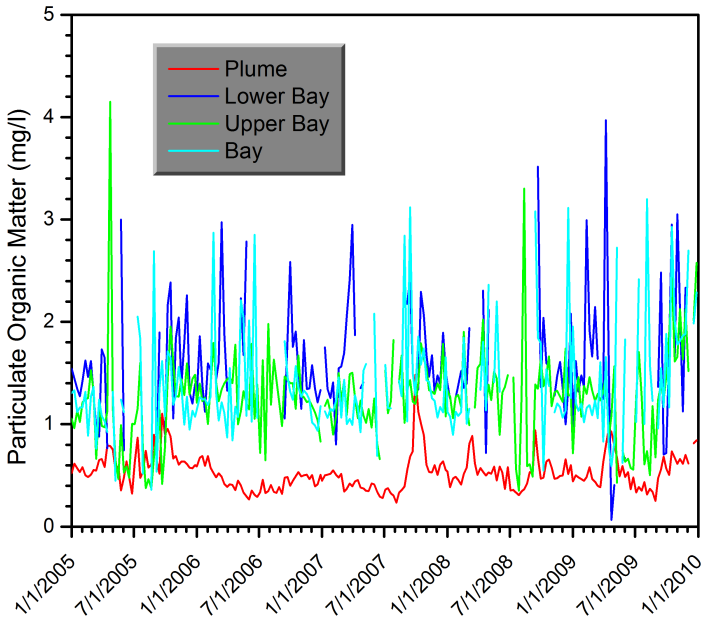


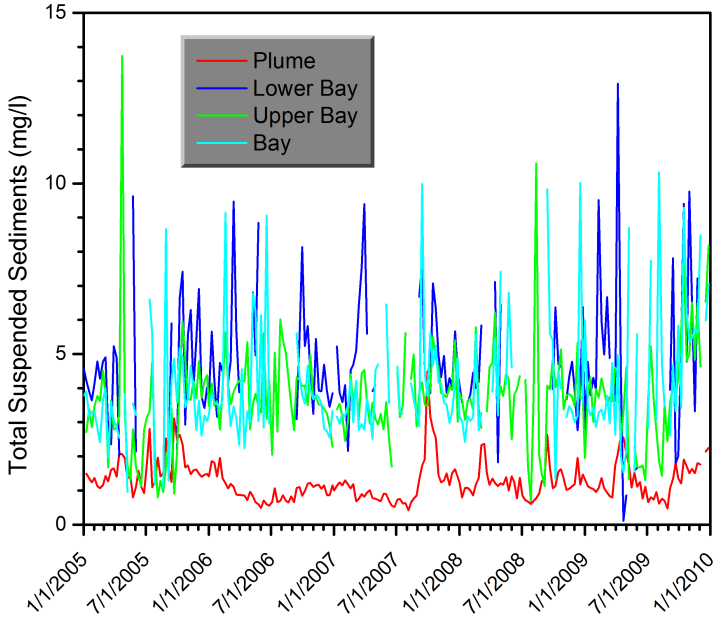


Time-Series Analysis – Within Bays

Weekly Averages For 5 Years (1/1/05-12/31/09), St. Andrew Bay

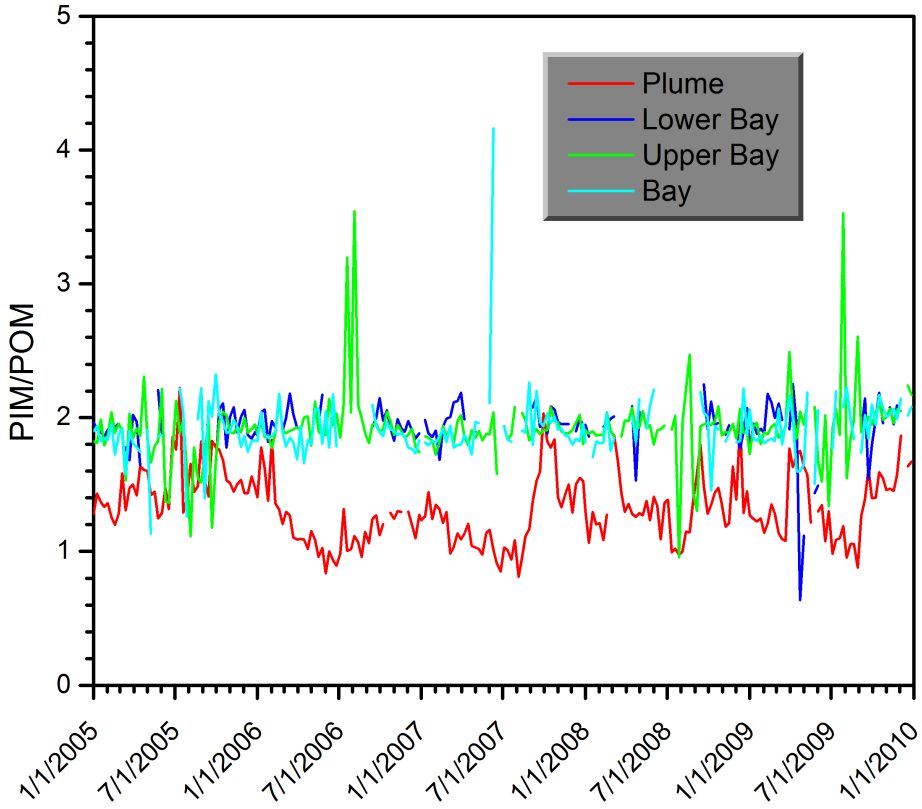


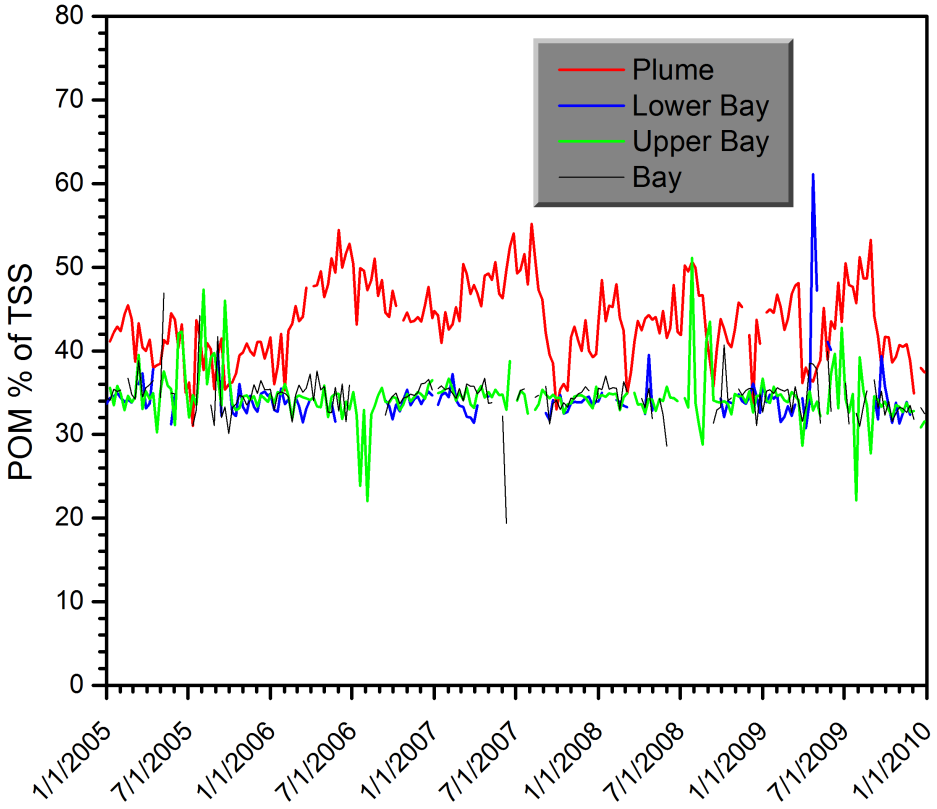




Time-Series Analysis – Within Bays

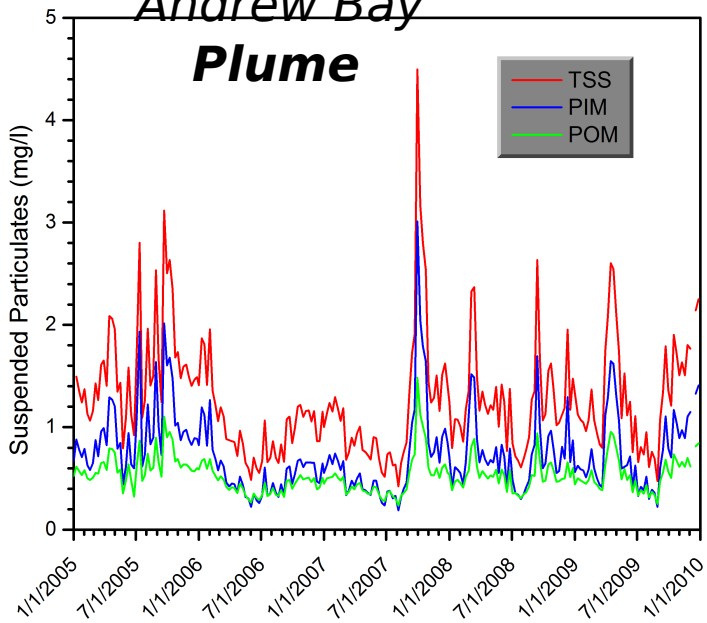
Weekly Averages For 5 Years (1/1/05-12/31/09), St. Andrew Bay

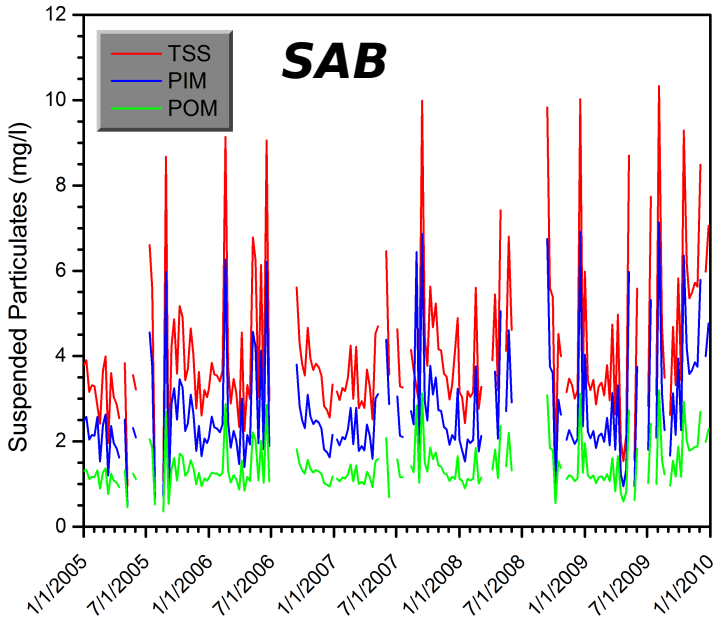


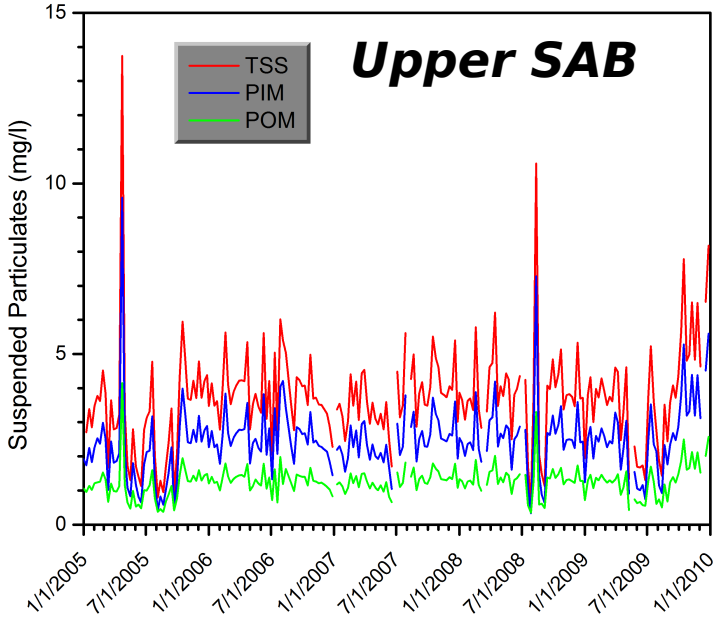


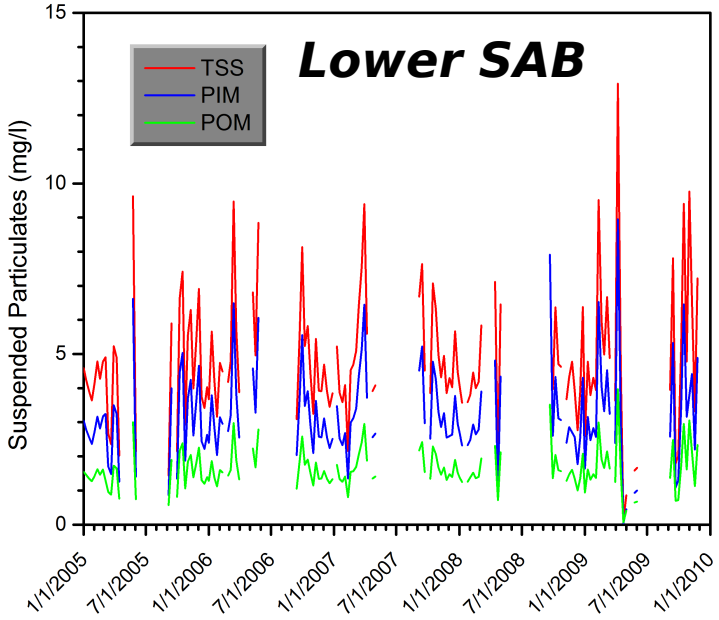
Time-Series Analysis – Within Bays

Weekly Averages For 5 Years (1/1/05-12/31/09), St. Andrew Bay



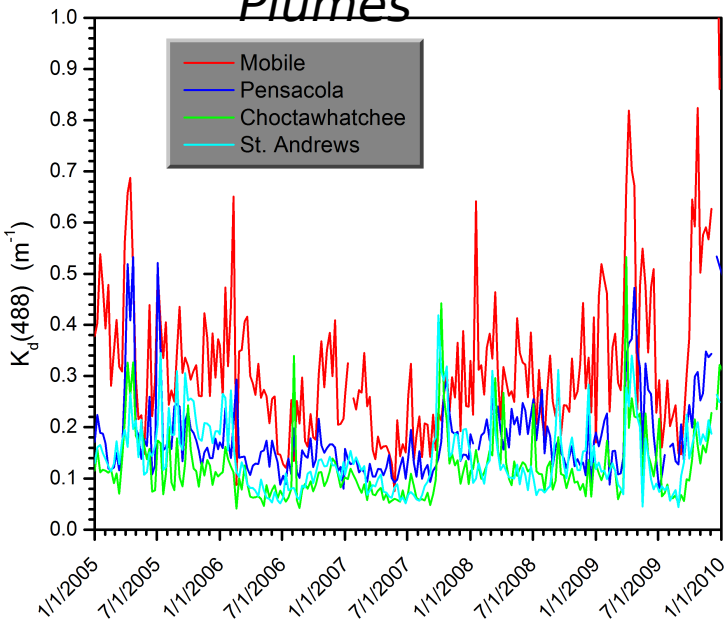


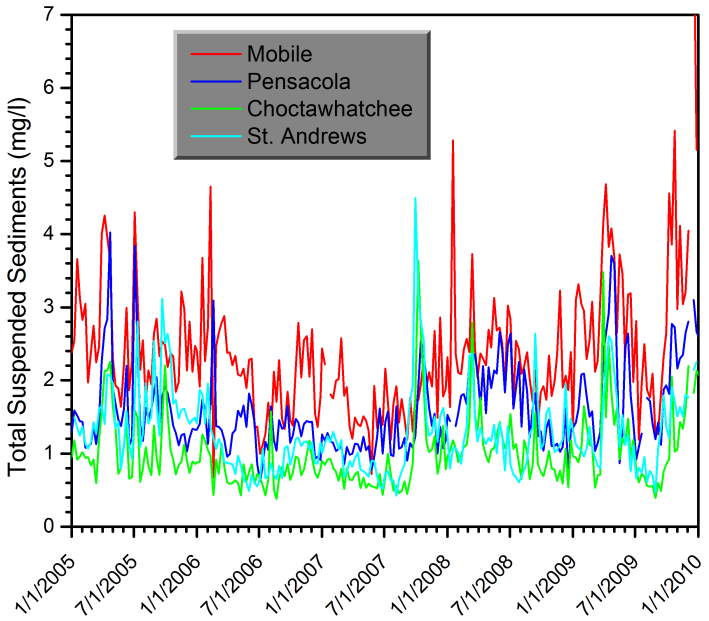


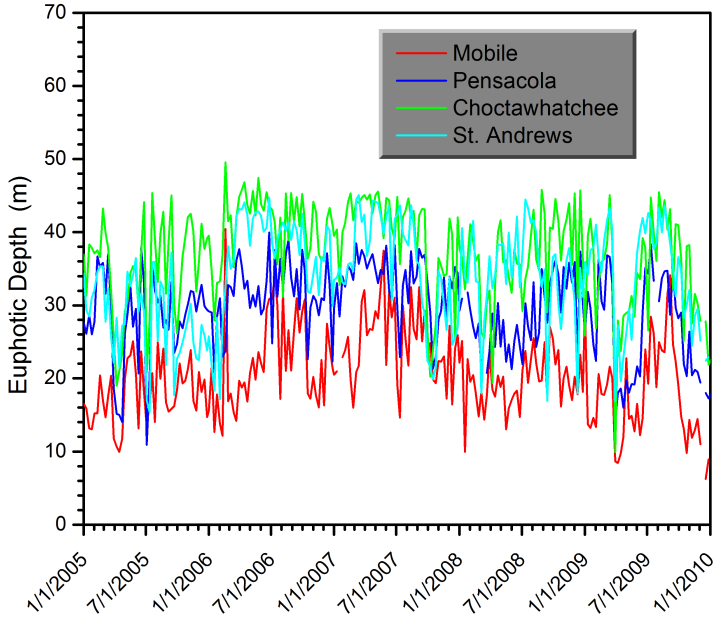


Time-Series Analysis – Between Bays

Weekly Averages For 5 Years (1/1/05-12/31/09), Plumes

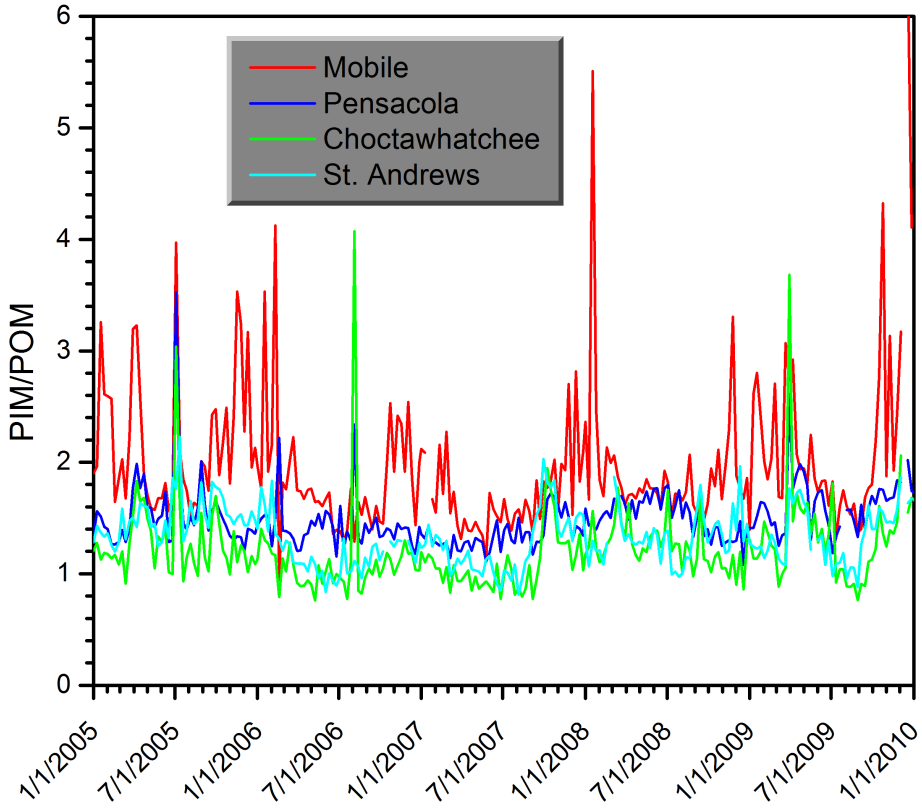


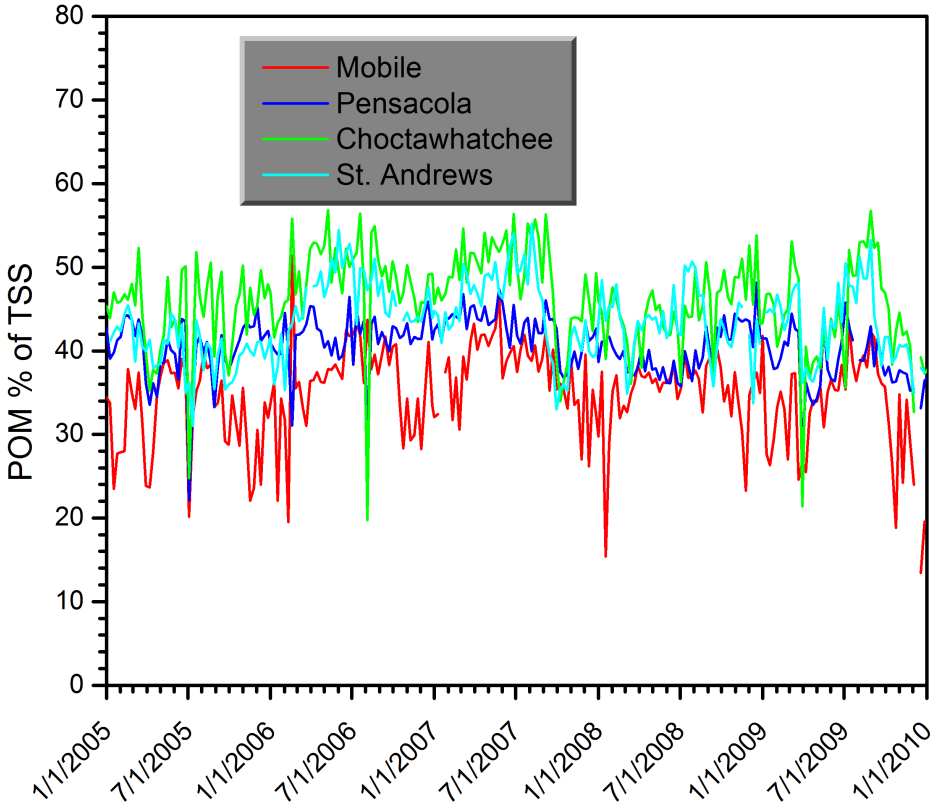




Time-Series Analysis – Between Bays

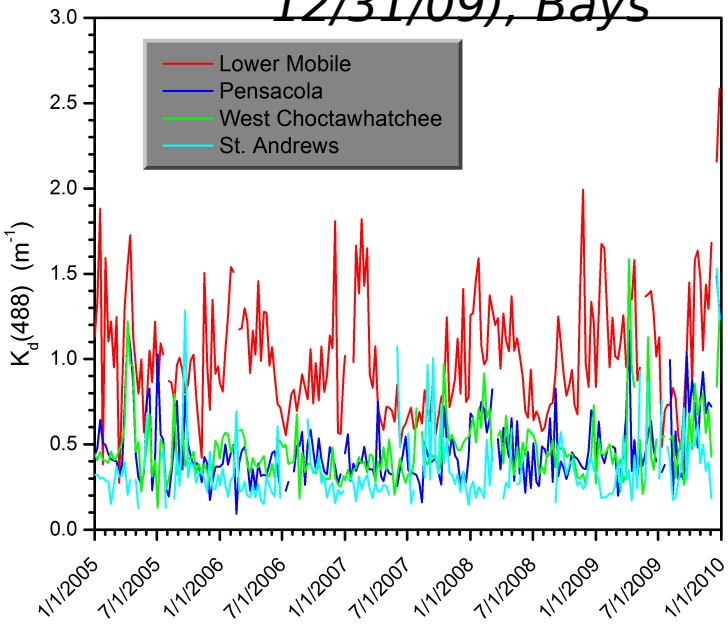
Weekly Averages For 5 Years (1/1/05-12/31/09), Plumes

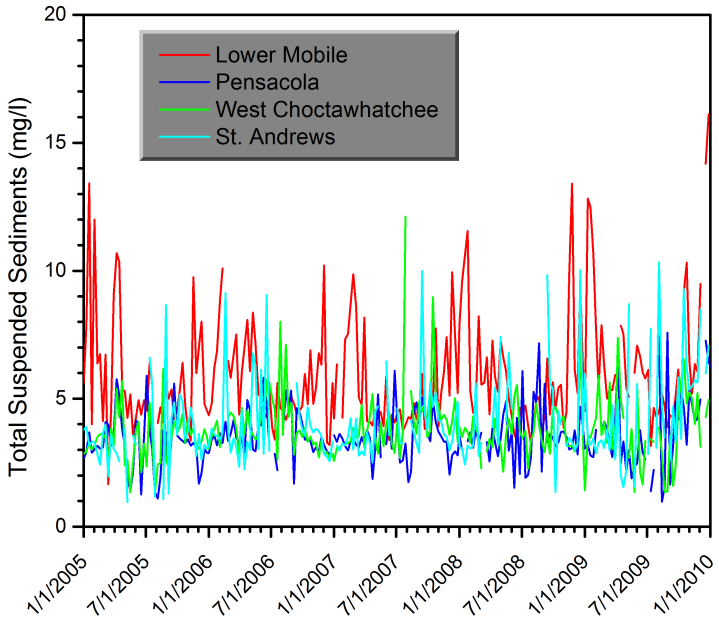


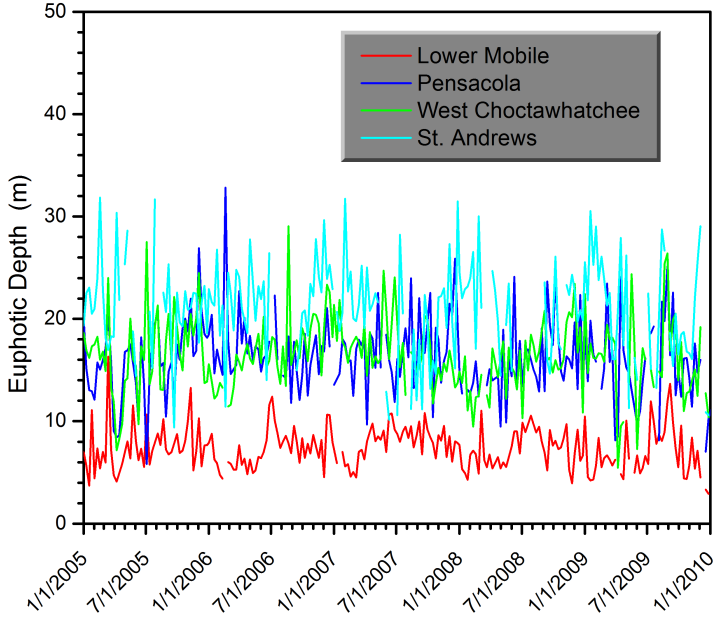


Time-Series Analysis – Between Bays

Weekly Averages For 5 Years (1/1/05-12/31/09), Bays

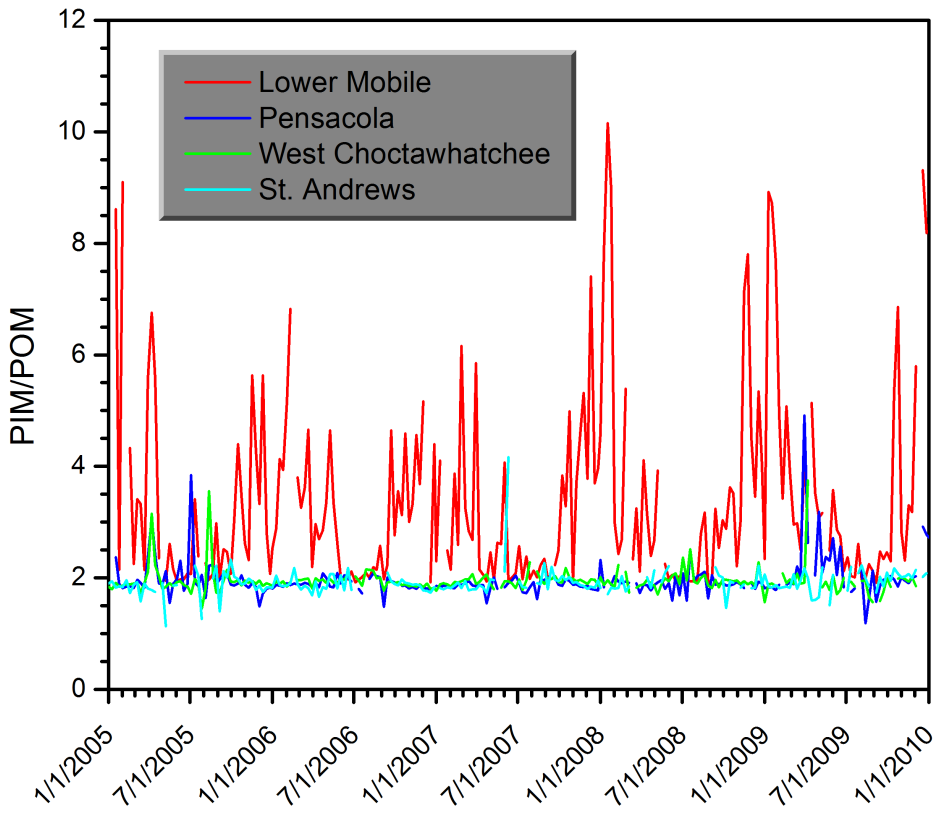


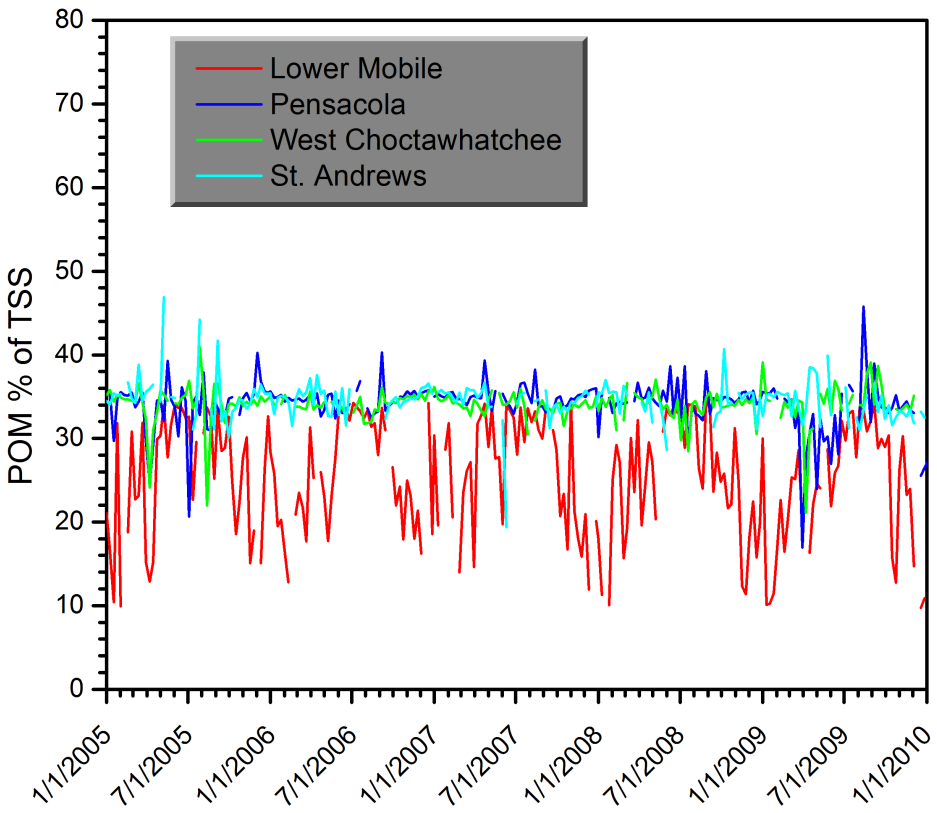




Time-Series Analysis – Between Bays

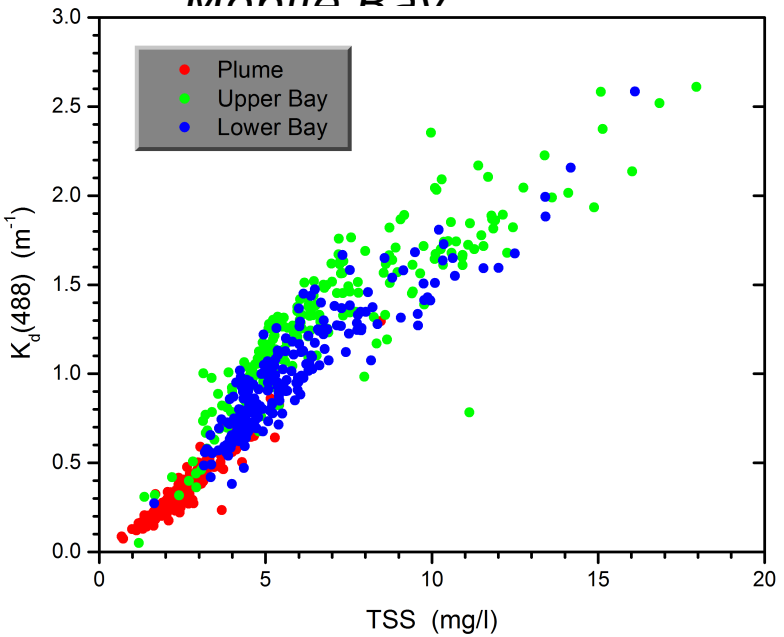
Weekly Averages For 5 Years (1/1/05-12/31/09), Bays

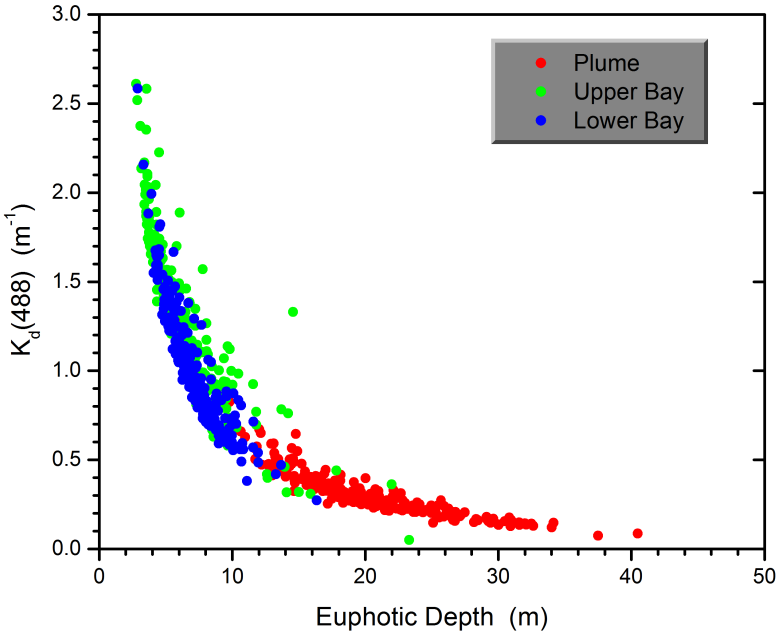


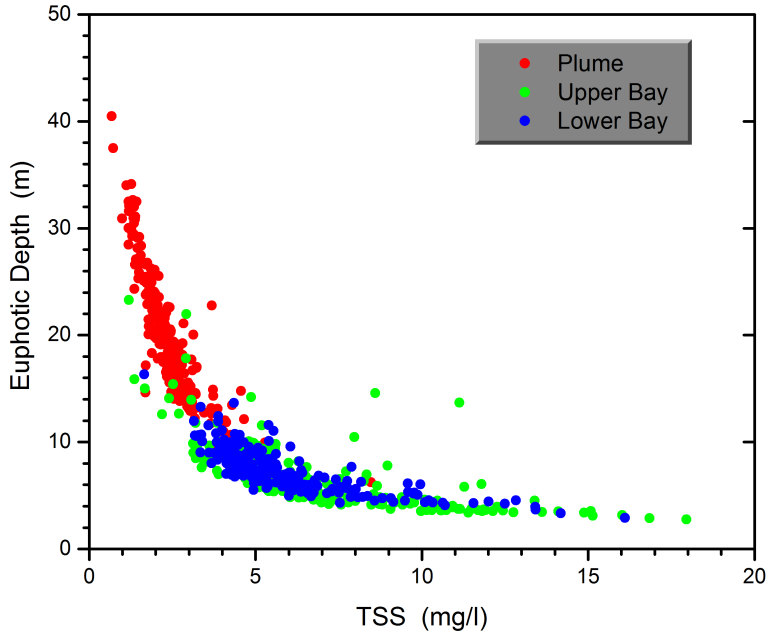


Bio-Optical Property Relationships – Within Bays

Weekly Averages For 5 Years (1/1/05-12/31/09), Mobile Bay

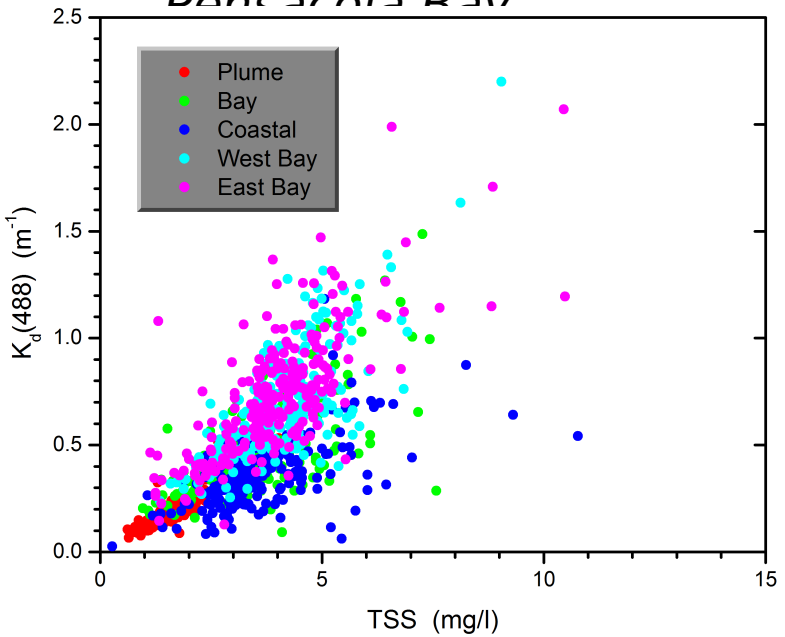


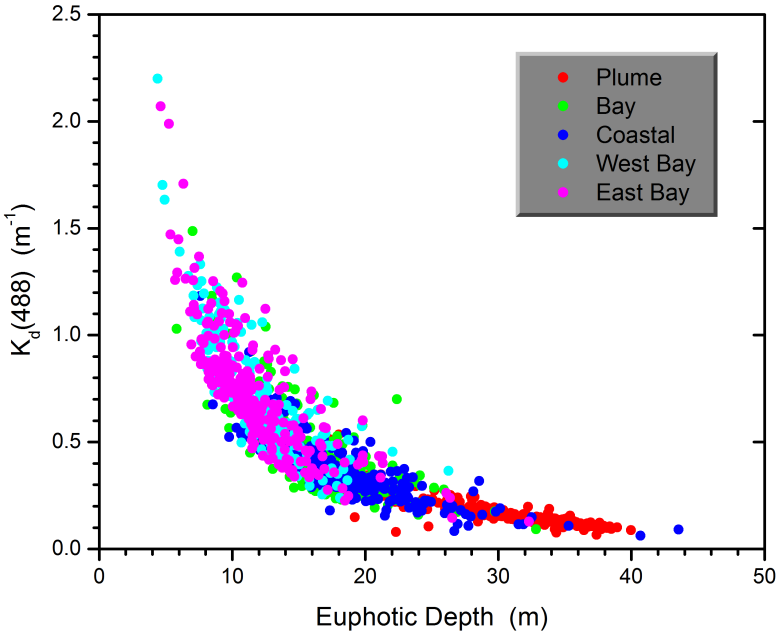


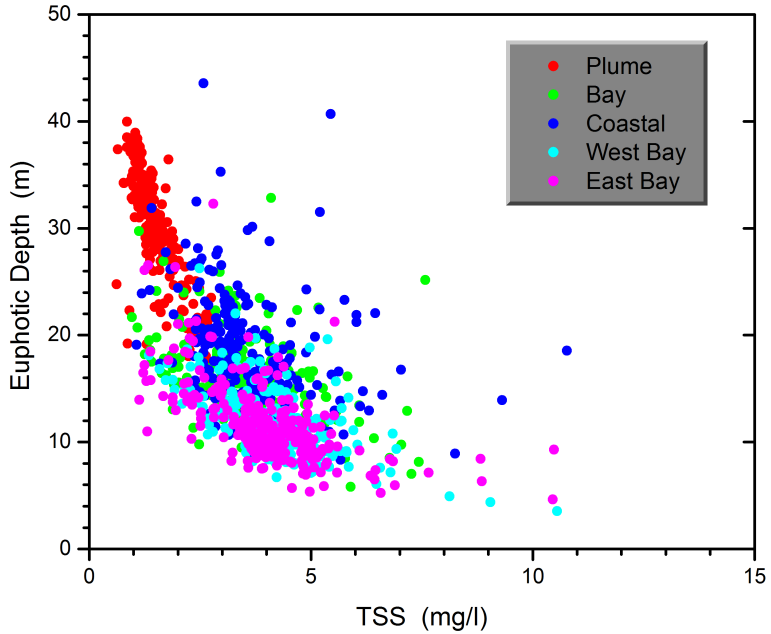


Bio-Optical Property Relationships – Within Bays

Weekly Averages For 5 Years (1/1/05-12/31/09), Pensacola Bay

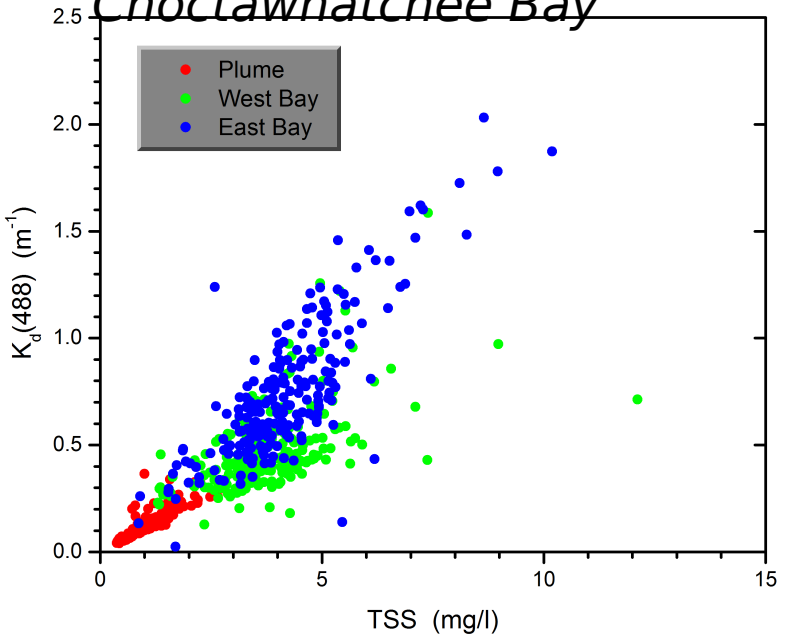


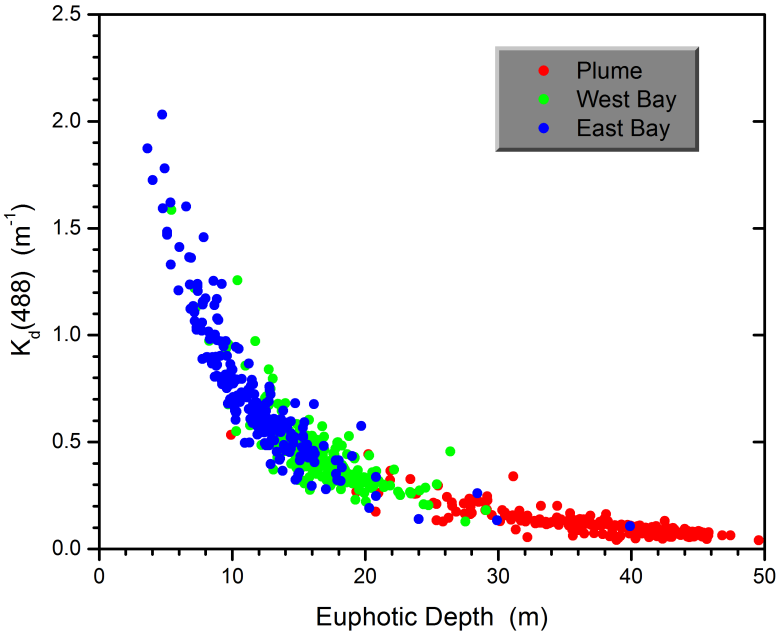


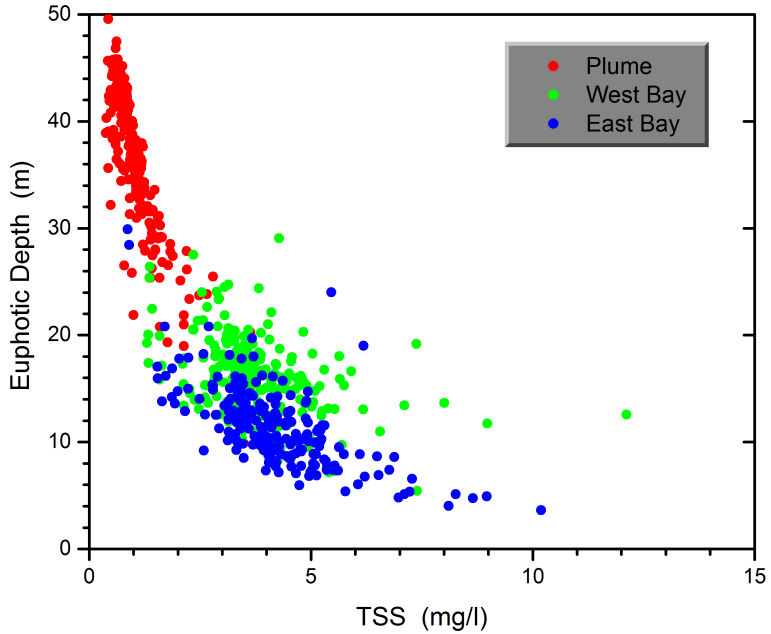


Bio-Optical Property Relationships – Within Bays

Weekly Averages For 5 Years (1/1/05-12/31/09), Choctawhatchee Bay

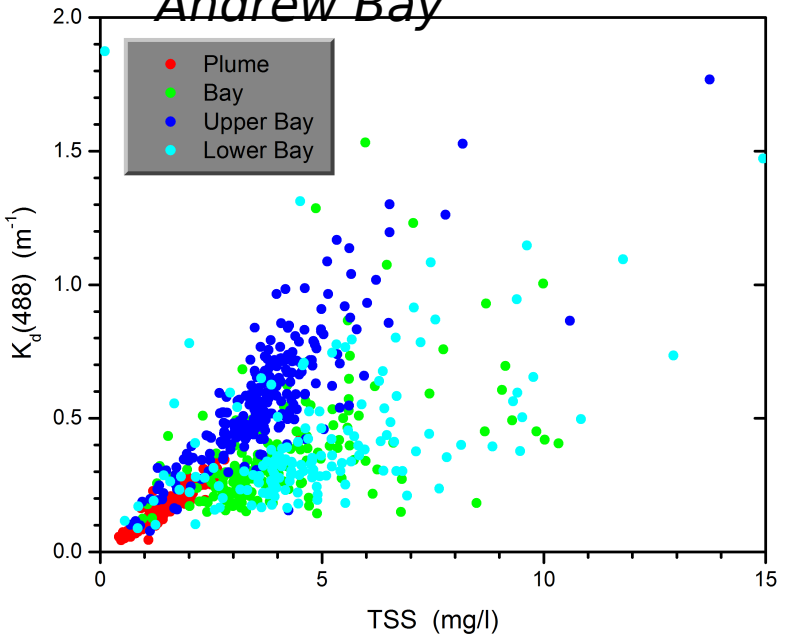


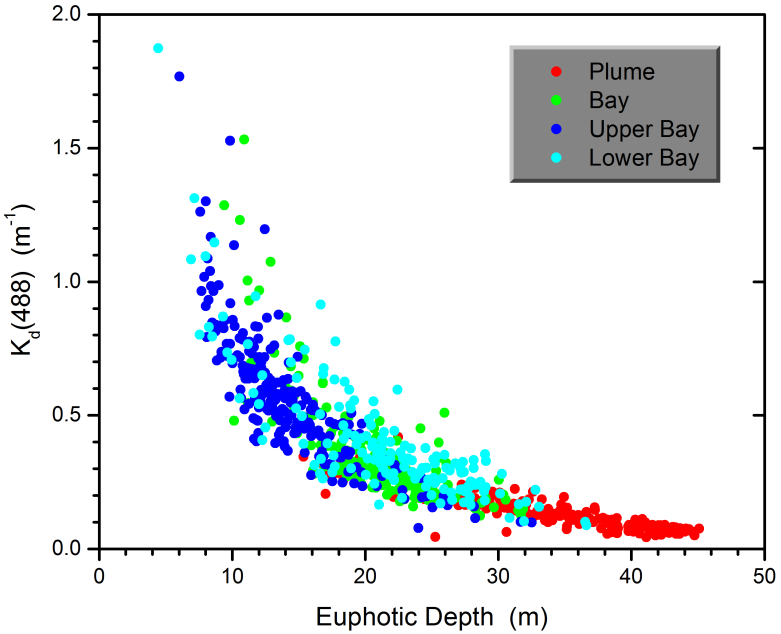


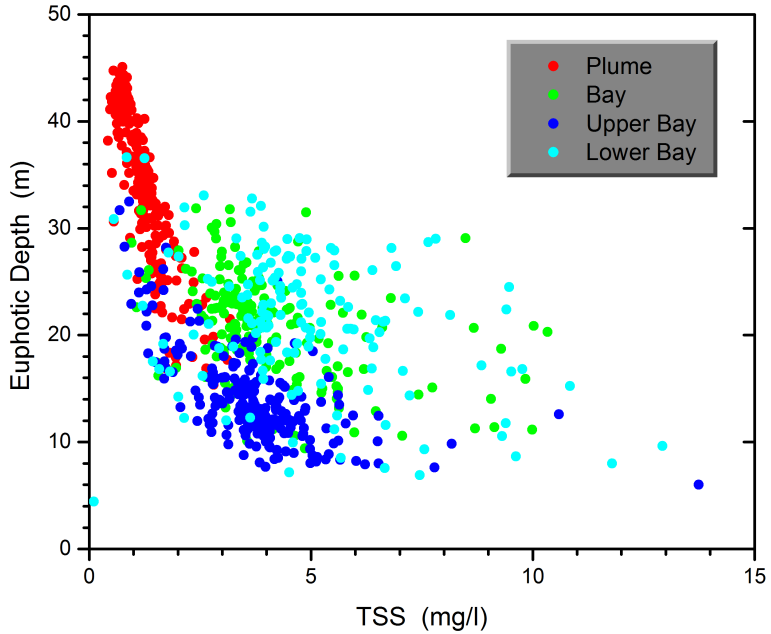


Bio-Optical Property Relationships – Within Bays

Weekly Averages For 5 Years (1/1/05-12/31/09), St. Andrew Bay

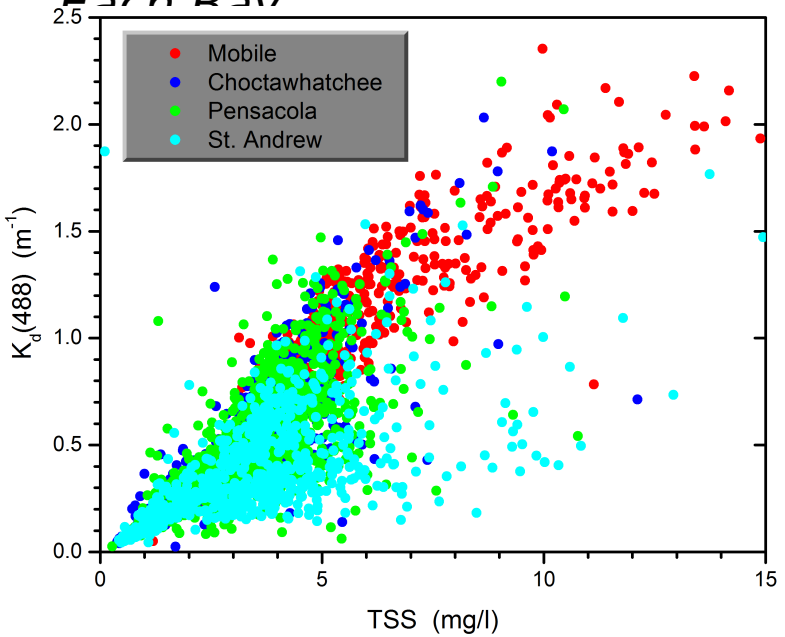


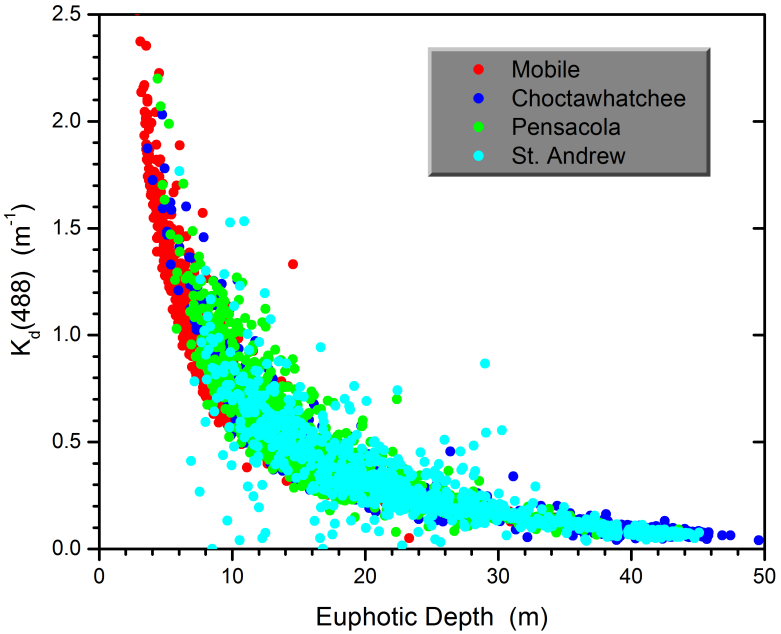


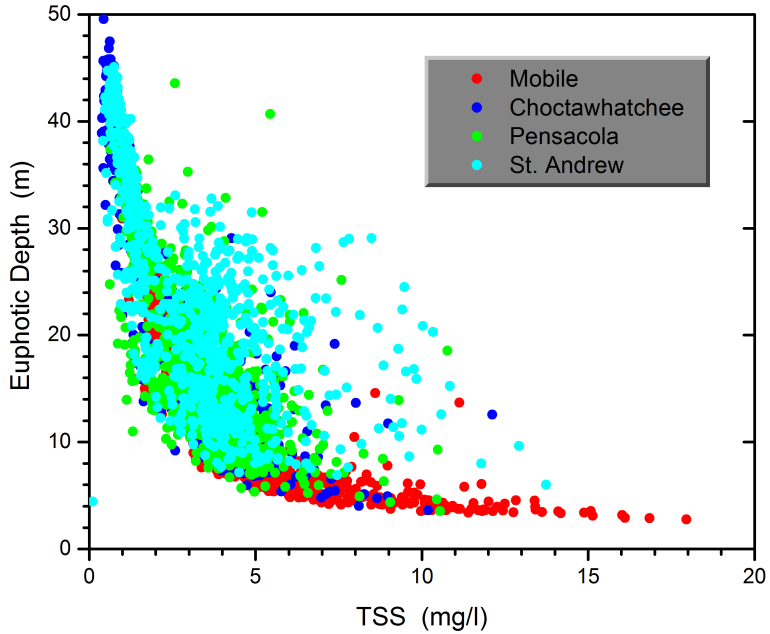


Bio-Optical Property Relationships – Between Bays

Weekly Averages For 5 Years (1/1/05-12/31/09), All Regions In Each Bay

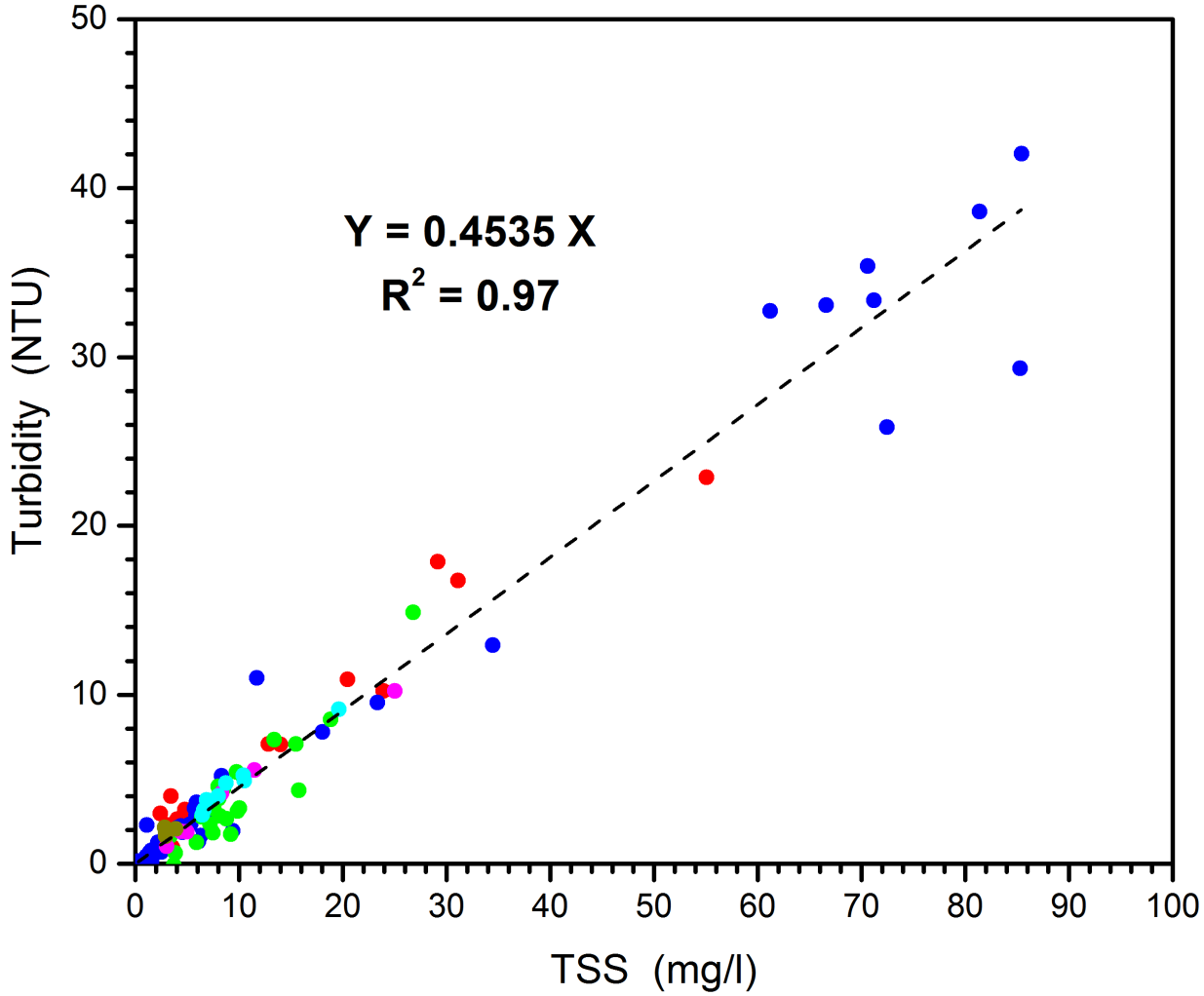






Bio-Optical Property Relationships

Turbidity (NTU) vs. Total Suspended Sediments (TSS)



- *Multiple cruises (6)*
- *Mississippi Bight, Mobile Bay samples*
- *Gravimetric TSS, Turner Aquafluor turbidity (NTU)*

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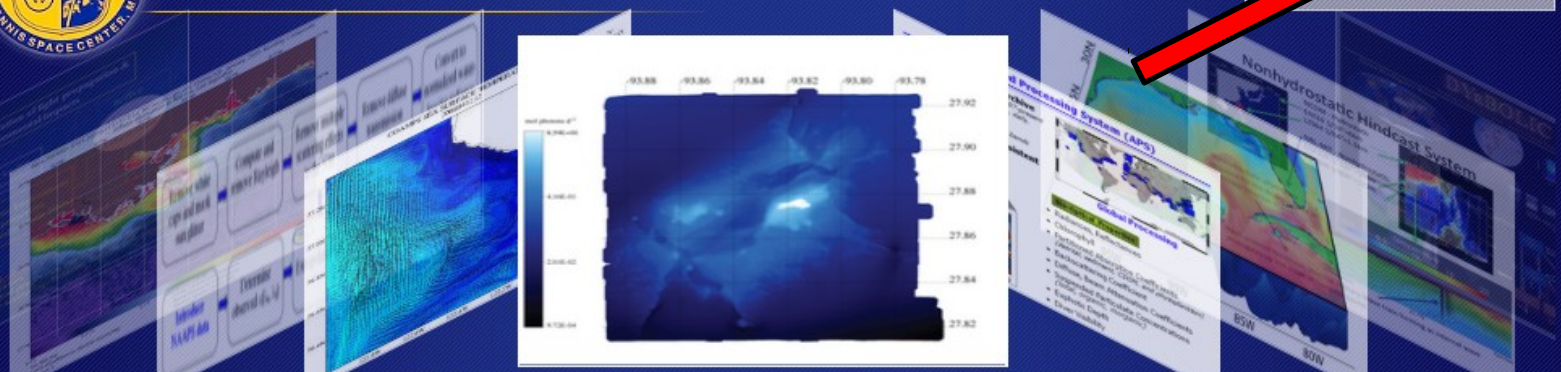

CLICK HERE: High-Resolution Subsurface Physical and Optical Property Fields in the Gulf of Mexico.
Establishing Baselines and Assessment Tools for Resource Managers

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Featured Stories

High-resolution (250m) baseline satellite bio-optical climatology developed for bays in northern Gulf of Mexico (CLICK HERE)

Tool developed to find and display current satellite imagery on a mobile device (See Mobile Image Tool link

Bio-Optical/Physical Processes and Remote Sensing Section Code 7331
Stennis Space Center, Mississippi 39529

As a team, members of the Bio-Optical/Physical Processes and Remote Sensing Section have broad experience and expertise in many aspects of remote sensing and coupled physical/ecological modeling. We conduct research to better understand oceanographic processes in coastal and open-ocean environments. Our overarching goal is to exploit this knowledge of the marine environment to address a wide variety of navy needs related to optical variability, underwater light penetration, and physical/optical forecasting. However, we also work closely with external agencies and universities to address a wide variety of oceanographic science questions. Our state-of-the-art facilities include satellite receiving and image processing/analysis systems, in situ and laboratory optical instrumentation, advanced physical and ecological models, and access to high-performance super computers. Recent instrumentation acquisitions include gliders (one with an Optical Plankton Discriminator), trawl-resistant physical/optical moorings, and a flow cytometer. Research interests within the section include ocean color algorithm

Bio-Optical Physical Processes and Remote Sensing Section

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Developing Ensemble Methods to Estimate Uncertainties in Remotely-Sensed Optical Properties (DEMEN)
NRL 6.4 Project: Modeling, Sensing and Forecasting Ocean Optical Products for Navy Systems
BIOSPACE (Bio-optical Studies of Predictability and Assimilation in the Coastal Environment
Dynamic Modeling of Marine Bioluminescence and Night Time Leaving Radiance
Satellite Ocean Color Remote Sensing and Hydrodynamic Modeling to Understand Hypoxia in the Northern Gulf of Mexico
Hyperspectral Imager for the Coastal Ocean (HICO)
3D Remote Sensing with a Multiple-Band Active and Passive System: Theoretical Basis
Characterizing Pelagic Habitats within U.S. Gulf of Mexico Coastal Waters Using Satellite Derived Data and Machine Learning Algorithms (Eco-Mapping)
Application of a Global Aerosol Forecast Model for Multi-Spectral Ocean Color Atmospheric Corrections
6.2 Resolving Bio-Optical Feedbacks to Ocean/Atmosphere Dynamics
High-Resolution Subsurface Physical and Optical Property Fields in the Gulf of Mexico: Establishing Baselines and Assessment Tools for Resource Managers
Automated Processing System (APS)
Decadal-Scale Changes in Oceanic Heat Content for the Gulf of Mexico: A Model Study with Multi-disciplinary Implications to Climate Change
Understanding and Forecasting Nonhydrostatic Dynamics in the Ocean
6.1 Modeling Dynamic Bio-Optical Layers in Coastal Systems (DYaBOLIC)
Transformational approach to monitoring water quality sustainability of coastal ecosystems from satellite remote sensing
Development of Hyperspectral Imaging to Detect Contamination in Plants
Improving Blended Multi-Sensor Ocean Color Products Through Assessment of Sensor Measurement Differences
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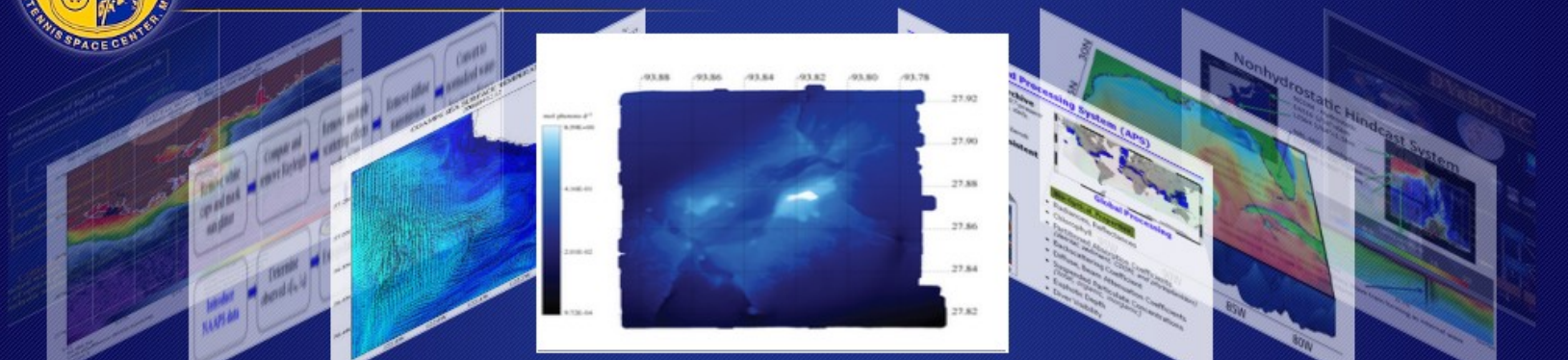


CLICK HERE: High-Resolution Subsurface Physical and Optical Property Fields in the Gulf of Mexico.
Establishing Baselines and Assessment Tools for Resource Managers

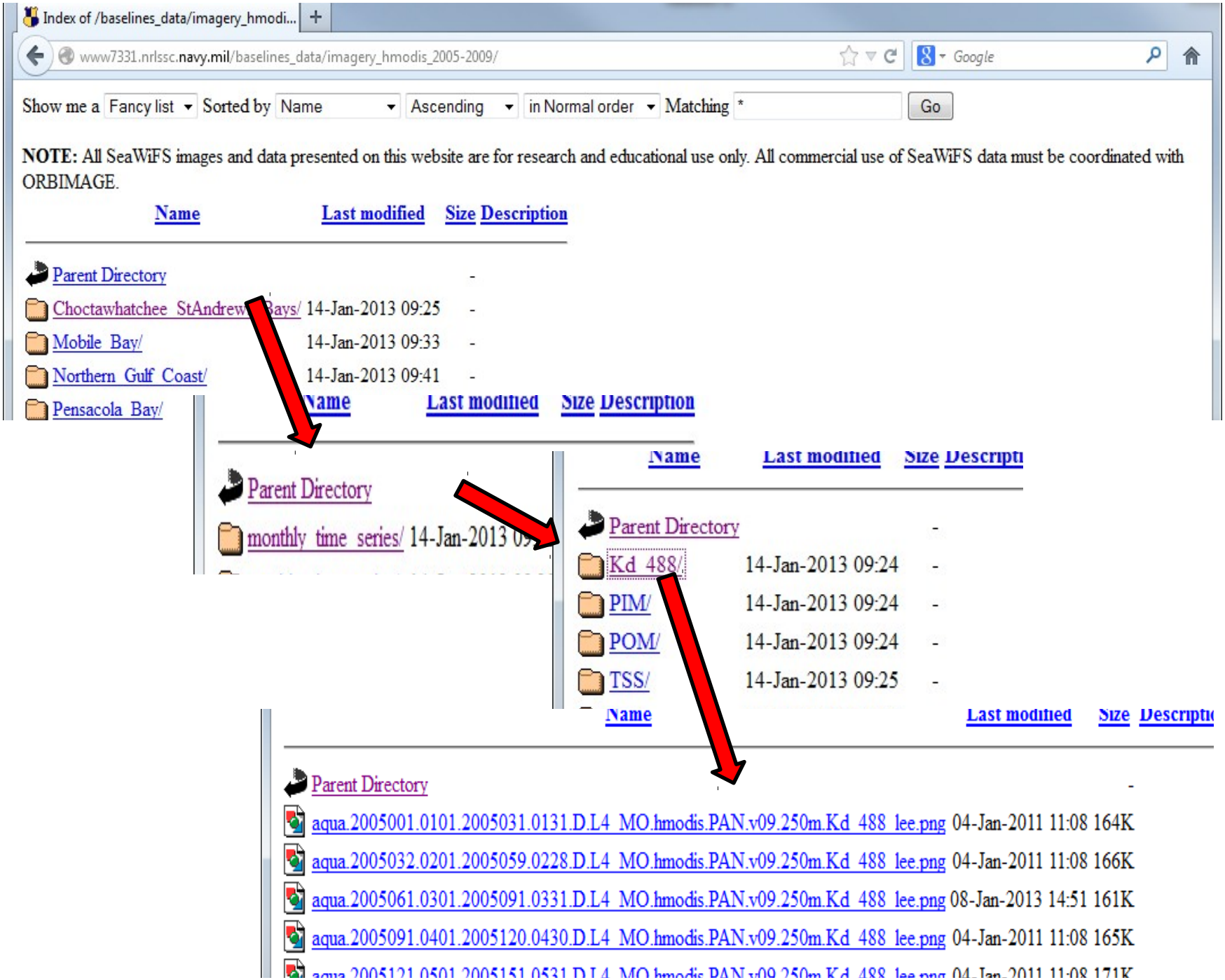
High-Resolution Subsurface Physical and Optical Property Fields in the Gulf of Mexico: Establishing Baselines and Assessment Tools for Resource Managers

Objective: We propose to provide a database of subsurface physical and optical property fields for specific local areas within the Gulf of Mexico using a blend of data assimilative ocean modeling tools and ocean color remote sensing products. These three-dimensional property fields are needed to inform the decision-making process of resource managers, with particular emphasis on (i) habitat identification and characterization, (ii) assessment of the environmental impact of various permitted activities, such as dredging, and (iii) water quality assessment. Accordingly, we have identified two specific decision-making processes within the Gulf of Mexico that will be aided by the establishment of our proposed database. First, the Flower Garden Banks National Marine Sanctuary (FGBNMS) works with the Sanctuary Advisory Council, constituents, and users to conduct periodic management reviews of current regulations. The FGBNMS is currently going through a review, and potential boundary expansion has been identified as a priority management issue. The boundary expansion proposals and deliberations would be significantly aided by knowledge of baseline environmental conditions, such as light, temperature, and salinity, for benthic biological communities that may be ecologically linked to the presently protected areas. Second, the natural variability of coastal turbidity (suspended sediment load) is not known for local areas where the United States Army Corps of Engineers (USACE) are required to monitor during their dredging, flood protection, and coastal restoration activities. Knowledge of this natural variability would provide a baseline against which data from their monitoring activities may be assessed. With the expressed support of FGBNMS-NOAA and USACE, we will provide high-resolution and three-dimensional light, temperature, salinity, and current field estimates, and surface maps of suspended sediment load, made from a combination of satellite remote sensing and ocean modeling. By providing both a regional context and local-scale details, these products will help resource managers make more informed decisions.

Image Climatology (2005-2009) Northern Gulf of Mexico Bays

Satellite-Extracted Data Files

Satellite Bio-Optics Project Summary Report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